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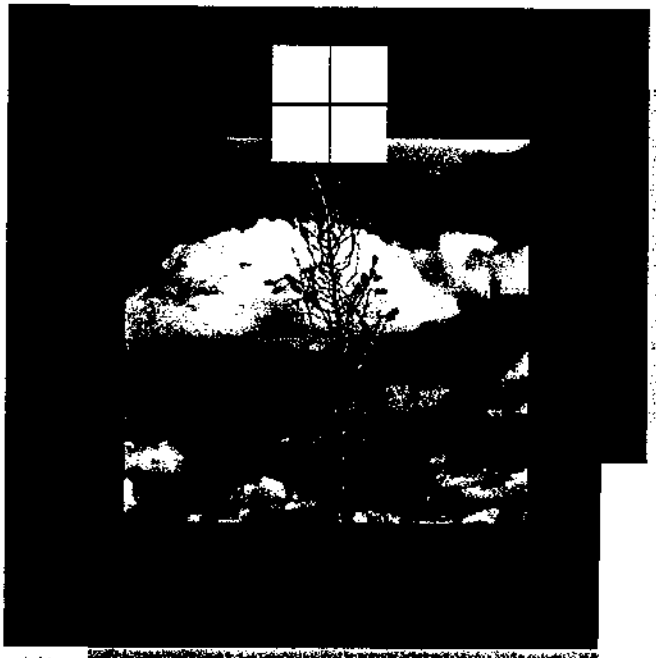

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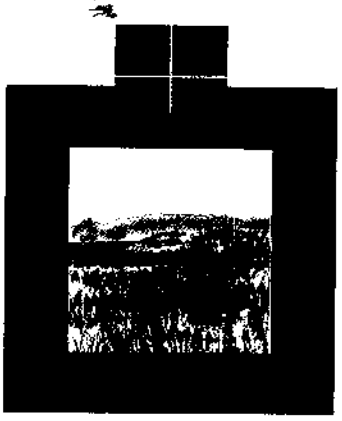

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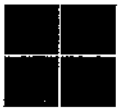

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DOE/WIPP-94-2033

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ACRONYMS AND ABBREVIATIONS

AEA	Atomic Energy Act
AIS	Air Intake Shaft
AMR	Annual Mitigation Report
AMS	Atmospheric Monitoring Station
ASER	Annual Site Environmental Report
BLM	U.S. Bureau of Land Management
BMP	Best Management Practices
Bq	Becquerel
CAA	Clean Air Act
C&C	Consultation and Cooperation
CEQ	Council on Environmental Quality
CERCLA	Comprehensive Environmental Response, Compensation and Liability Act (also known as Superfund)
CFR	Code of Federal Regulation
CH-TRU	Contact Handled Transuranic Waste
CT-1	Control 1
CT-2	Control 2
CWA	Clean Water Act
CX's	Categorical Exclusions
CY	Calendar Year
DOE	U.S. Department of Energy
DOE-EML	U.S. Department of Energy, Environmental Measurements Laboratory
DOL	U.S. Department of Labor
EA	Environmental Assessment
EC	Electrical Conductivity
EDF	Environmental Defense Fund

ACRONYMS AND ABBREVIATIONS

(Continued)

EEG	Environmental Evaluation Group
Eh	Oxidation-Reduction Potential
EIS	Environmental Impact Statement
EML	Environmental Measurement Laboratory
EMP	Ecological Monitoring Program
EO	Executive Order
EPA	U. S. Environmental Protection Agency
EPCRA	Emergency Planning and Community Right-to-Know Act
ESA	Endangered Species Act
FDA	Fluorescardiacetate Hydrolysis Assay
FEIS	Final Environmental Impact Statement
FIFRA	Federal Insecticide, Fungicide, and Rodenticide Act
FLPMA	Federal Land Policy Management Act
FR	Federal Register
FSAR	Final Safety Analysis Report
FT	Feet
FWPCA	Federal Water Pollution Control Act
GSP	Groundwater Surveillance Program
HEPA	High Efficiency Particulate Air (filter)
HMTA	Hazardous Material Transportation Act
HSWA	Hazardous and Solid Waste Amendments
HW	Hazardous Waste
INEL	Idaho National Engineering Laboratory
LLCL	Low Level Counting Laboratory
LWA	Land Withdrawal Act
MOU	Memorandum of Understanding
MPS	Meters Per Second

ACRONYMS AND ABBREVIATIONS
(Continued)

MSHA	Mine Safety and Health Administration
NCP	National Contingency Plan
NEPA	National Environmental Policy Act
NES	Nonradiological Environmental Surveillance
NESHAPs	National Emissions Standard for Hazardous Air Pollutants
NHPA	National Historic Preservation Act
NM	New Mexico
NMD	No-Migration Determination
NMED	New Mexico Environment Department
NMGF	New Mexico Department of Game and Fish
NMIMT	New Mexico Institute of Mining and Technology
NOD	Notice of Deficiency
NPDES	National Pollution Discharge Elimination System
NRC	Nuclear Regulatory Commission
NW 2	Northwest 2
NWPA	National Waste Policy Act
OEMP	Operational Environmental Monitoring Plan
OSHA	Occupational Safety and Health Administration
PCB	Polychlorinated Biphenyls
pH	Hydrogen-Ion Activity of a System
PRS	Project Records Services
QA	Quality Assurance
QAP	Quality Assurance Program
QC	Quality Control
RBP	Radiological Baseline Program
RCRA	Resource Conservation and Recovery Act
RES	Radiological Environmental Surveillance

ACRONYMS AND ABBREVIATIONS
(Continued)

ROD	Record of Decision
SARA	Superfund Amendments and Reauthorization Act
SDWA	Safe Drinking Water Act
SE-1	Southeast 1
SE-2	Southeast 2
SEIS	Supplement Environmental Impact Statement
SEN	Secretary of Energy Notice
SERC	State Emergency Response Commission
SHPO	State Historic Preservation Officer
SIC	Standard Industrial Code
SNL	Sandia National Laboratories
SPDV	Site Preliminary Design Validation
SWPPP	Storm Water Pollution Prevention Plan
TDS	Total Dissolved Solids
TRU	Transuranic
TSCA	Toxic Substances Control Act
TSDF	Treatment, Storage, and Disposal Facility
TSP	Total Suspended Particles
UIC	Underground Injection Control
USFWS	U.S. Fish and Wildlife Service
UST	Underground Storage Tank
VOCs	Volatile Organic Compounds
WIPP	Waste Isolation Pilot Plant
WPSO	WIPP Project Site Office
WQSP	Water Quality Sampling Program

PREFACE

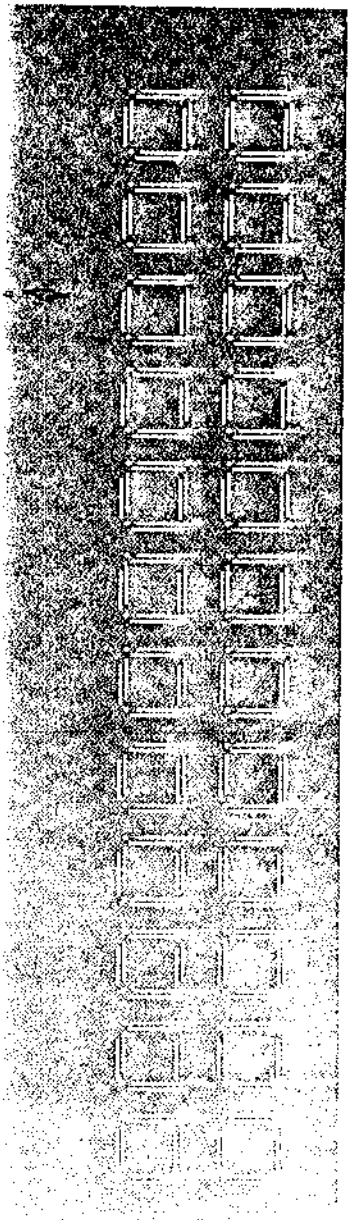
1993 WIPP Site Environmental Report

Preface

This is the tenth Annual Site Environmental Report (ASER), documenting the progress of environmental programs at the U.S. Department of Energy (DOE) Waste Isolation Pilot Plant (WIPP). The most significant change affecting the WIPP facility in 1993 was the cancellation of the Test Phase. All activities pertaining to the Test Phase will now be conducted at the Idaho National Engineering laboratory.

Even though the cancellation of the Test Phase was a significant change in work scope for the WIPP, there are still numerous environmental monitoring and reporting activities that must be preformed as a routine part of daily operations. These activities, and the WIPP's ability to demonstrate compliance with both state and federal environmental compliance requirements, are documented in this report.

This report is a compilation and summarization of environmental data collected at the WIPP site. Should a reader of this report desire to obtain copies of the raw data used to generate this document, please write the U.S. Department of Energy, Manager of the Environment, Safety and Health Department, at P.O. Box 3090, Carlsbad, NM 88221.



CHAPTER 1

EXECUTIVE SUMMARY

Chapter 1
Executive Summary

The U.S. Department of Energy (DOE) Waste Isolation Pilot Plant (WIPP) Environmental Monitoring Plan (EMP) defines a comprehensive set of parameters that must be monitored to detect potential impacts to the environment and to establish baseline measurements for future environmental evaluations. Surface water and groundwater, air, soil, and biotics must be monitored for radiological and nonradiological activity levels. Nonradiological studies focus on the area immediately surrounding the WIPP site with emphasis on the salt storage pile. The baseline radiological surveillance covers a broader geographic area that expands to encompass nearby ranches, villages, and cities.

Since the WIPP is still in its preoperational phase (i.e., no waste has been received), certain operational requirements specified in DOE Orders 5400.1 and 5400.5, and in the *Environmental Regulatory Guide for Radiological Effluent Monitoring and Environmental Surveillance* (DOE/EH-0173T) are not yet relevant. Therefore this report does not discuss programs and activities that will be developed to meet future (operational requirements) such as those concerned with radionuclide emissions and effluents and their impact upon the public and the environment.

1.1 Compliance Summary

A summary of significant compliance-related issues and actions at the WIPP during Calendar Year (CY) 1993 presented in this section. The major environmental statutes and Executive Orders applicable to the WIPP, along with compliance status, and the significant issues, actions, and accomplishments at the WIPP facility in the CY 1993 as they relate to each statute, are described in Chapter 3 of this report.

Revision 3 of the Resource Conservation and Recovery Act (RCRA) Part B permit application was submitted to the New Mexico Environment Department (NMED) in January 1993. The NMED issued a test-phase draft permit for the WIPP facility in August 1993 for public comment. At the conclusion of the public comment period on January 15, 1994, the DOE requested from the New Mexico Environment Department (NMED) the opportunity to revise the Part B permit application, to reflect the October 1993 decision to redirect Test Phase activities from the WIPP to one of national laboratories, and thus, to more accurately describe the programmatic direction of the WIPP.

In addition, a report titled *No-Migration Determination Annual Report for the Period of September 1992 through August 1993* was submitted to the Environmental Protection Agency (EPA) Region VI

and to EPA Headquarters on November 9, 1993, to satisfy the annual reporting requirement of the No-Migration Determination (NMD).

The WIPP also validated the bin-case reports for the sixth and seventh bins of waste planned for shipment to the WIPP facility. The bin case addendum reports were validated for bins four, six, and seven. These reports contain the results of the waste analysis efforts conducted at the Idaho National Engineering Laboratory (INEL) for shipment to the WIPP site. After review of these reports, the WIPP concluded that the bins may be emplaced in the WIPP repository in compliance with the Waste Analysis Plan of the RCRA Part B permit application and the NMD.

On February 9, 1994, the WIPP submitted the *Emergency and Hazardous Chemical Inventory Report* for CY 1993 to the New Mexico (NM) State Emergency Response Commission, the Eddy County Local Emergency Planning Committee, and the local fire department with jurisdiction over the WIPP site, as required by Section 312 of the Superfund Amendments and Reauthorization Act (SARA) Title III. In March 1994 the WIPP submitted the Emergency and Hazardous Chemical Inventory Report for CY93 to all the appropriate organizations.

The WIPP National Environmental Policy Act (NEPA) Compliance Program has been developed to ensure the requirements of the NEPA are fulfilled at the WIPP site. The program specifies that those responsible for the planning, coordination, and performance of work follow the provisions of NEPA and that these provisions be applied appropriately for work performed at the WIPP. Furthermore, the NEPA Compliance Program details the actions taken in the evaluation of work documents for NEPA Compliance in accordance with DOE Order 5440.1E and Secretary of Energy Notice (SEN) 15-90.

In April 1993, Westinghouse Electric Corporation Waste Isolation Division (WID) completed the *WIPP Hazardous Air Pollutants (HAPs) Emission Inventory* (WP 02-15). The HAPs inventory was developed as a baseline document to calculate maximum potential hourly and annual emissions of both hazardous and criteria air pollutants. The HAPs inventory calculated emissions estimates for the three Carlsbad Area Office (CAO) locations. These locations include the WIPP site, the CAO located at Greene Street, and the WID Canal Street office. Emission estimates were used to determine if the WIPP is required to obtain an air permit under state or federal regulations.

On June 18, 1993, the DOE submitted an Air Quality Control Regulations (AQCR) 702 permit application for the WIPP back-up diesel generators. The New Mexico Air Quality Bureau issued Air Quality Permit 310-M-2 on December 7, 1993. On February 26, 1994, the WIPP completed the emission monitoring requirements established in the permit. With the submittal of the *Final*

Compliance Sampling Report on March 28, 1994, the DOE has fulfilled all monitoring and reporting requirements identified in the permit.

Section 402 of the Clean Water Act, the National Pollutant Discharge Elimination System (NPDES) program, establishes requirements for regulating industrial storm water runoff that has the potential to discharge into waters of the United States. The WIPP submitted a Notice of Intent to the EPA to obtain a NPDES Storm Water General Permit. On December 31, 1992, the EPA issued a New Mexico NPDES Storm Water General Permit (NMR00A021). The WIPP completed the WIPP *NPDES Storm Water Pollution Prevention Plan* (PPP) in March 1993. The NPDES Storm Water General Permit rules require that a PPP be developed for each facility covered under the permit by April 1, 1993. The PPP identifies and assesses potential pollutant sources, and describes all Best Management Practices (BMPs) that have been implemented to ensure that storm water runoff does not contact regulated pollutants.

The WIPP has applied for and received an approved Discharge Plan (DP-831) for the WIPP sewage facility. The Discharge Plan approves the construction, sampling, and management requirements for the facility. The expansion of the sewerage system was completed in April 1993. This expansion included the construction of a lined evaporation pond divided into two cells.

The WIPP continues to conduct a training program aimed at informing all WIPP personnel of their responsibilities under RCRA. The level of training provided under the program is contingent upon the employees' job titles and duties. All employees receive introductory RCRA training in the class *General Employee Training* at the WIPP.

On October 30, 1992, President Bush signed the Waste Isolation Pilot Plant Land Withdrawal Act (LWA) transferring land from the public domain for use by the DOE. The LWA establishes an extensive regulatory framework that governs the conduct of the WIPP Test Phase and, if all requirements are successfully met, the Disposal Phase.

The *Land Management Plan* has been prepared for the WIPP withdrawal area by the DOE in consultation with the U.S. Bureau of Land Management (BLM), and the State of New Mexico. The *Land Management Plan* was issued October 30, 1993. This plan encourages the public and local, state, and federal agencies to participate in the land use planning process.

A Memorandum of Understanding (MOU) between the DOE and the BLM is being prepared and should be issued by May 1994. This MOU outlines the responsibilities of each agency with regard to

land use management for the withdrawal area, and provides an additional mechanism to protect the withdrawal area from unallowable or inadvertent uses. The *Land Management Plan* and the MOU will serve to provide equitable and consistent administration of archaeological resources within the WIPP withdrawal area.

1.2 Environmental Program Information

The effort to establish environmental baseline conditions at the WIPP site before arrival of waste began in 1975. These studies are continuing to characterize the local environment both radiologically and nonradiologically until the WIPP site is operational. Once the site is operational, these programs will transition into the operational phase and the environment will be monitored constantly throughout the life of the project.

1.2.1 Environmental Monitoring Plan

The WIPP EMP provides schedules and guidelines for monitoring a comprehensive set of parameters in order to detect and quantify present or potential environmental impacts. Nonradiological portions of the program focus on the immediate area surrounding the WIPP site. The radiological surveillance generally covers a broader geographic area, one that includes nearby ranches, villages, and cities. Environmental Monitoring will continue at the WIPP site during project operations and throughout decommissioning activities. The sampling activities will continue to be performed at the monitoring locations established by the EMP. Monitoring parameters may need to be modified from time-to-time to ensure a technically sound program. None of these monitoring parameters will be changed, however, without the revision and approval of the EMP.

1.2.2 Raptor Research Program

In CY93 the Raptor Program focused on the impacts of human-related activities on four distinct groups of Harris' Hawks (*Parabuteo unicinctus*). During the course of the year, nest locations of the hawks were identified and nestlings were banded with U.S. Fish and Wildlife Service (USFWS) bands and with color bands with alpha numeric codes. These groups will serve as indicators for the data-sharing network between the WIPP and the BLM. Also, during the year nest locations of additional Harris Hawk groups and other

nesting species (e.g., Swainson's Hawks, Chihuahuan Ravens) were located. Nest locations were identified with Loran Navigators and these location were provided to the BLM for incorporation into their determinations per land use activities.

1.2.3 Reclamation of Disturbed Lands

Reclamation activities during CY93 consisted of constructing a fence around an existing reclamation site. The fence was constructed according to BLM specifications. Surface areas that retained water were hand seeded and minor erosion control measures were implemented. Additionally, a construction landfill area was capped and reseeded to bring the facility into compliance with NPDES stormwater discharge permit requirements.

1.3 Environmental Radiological Program Information

The following subsections present monitoring topics for the subprograms of the EMP. These programs are consistent with policies established in the *Environmental Regulatory Guide for Radiological Effluent Monitoring and Environmental Surveillance*, (DOE/EH-0173T).

DOE Order 5400.1 requires that a radiological baseline be established during the preoperational phase. Once a radiological baseline has been established, many of the radiological sampling programs can be redirected to collecting samples to archive for future analysis. As specifically outlined in the EMP, five subprograms are being conducted to document the background levels of potential radionuclide pathways leading from the WIPP to the environment and the public.

These five subprograms are presented in the *Statistical Summary of the Radiological Baseline Program (RBP) for the Waste Isolation Pilot Plant* (DOE/WIPP 92-037).

1.3.1 Airborne Particulate and Effluent Monitoring

WIPP began sampling airborne aerosol particulates in 1985 and this sampling activity continues to be an important subprogram of the EMP. The *Final Safety Analysis Report* (FSAR) (DOE, 1990) identifies the atmosphere pathway as the only pathway potentially capable of exposing the public to radiation. To monitor this pathway, particulate aerosol samplers continuously operate at eight locations: three within 1000 meters of the facility boundary, four at local ranches and communities, and one at a sample control site.

counted at the Low-Level Counting Laboratory at the WIPP site. The weekly filters are counted for gross alpha and beta activity. The data are then grouped into 13-week segments or calendar quarters and are presented as a calculated quarterly average. Table 5-1 lists the quarterly alpha and beta concentrations for each sampling location.

1.3.2 Soil Sampling

Soil samples were collected in CY93. However, due to discrepancies identified in the contract laboratory analytical contract, no radiological soil sampling data will be presented in the CY93 WIPP ASER. Two years of baseline soil analysis data were previously documented in DOE/WIPP 92-037.

1.3.3 Groundwater

Groundwater samples were collected in CY93. However, due to discrepancies identified in the contract laboratory analytical contract, no radiological groundwater sampling data will be presented in the CY93 WIPP ASER. Two years of baseline groundwater analysis data were previously documented in DOE/WIPP 92-037.

1.3.4 Surface Water and Sediment Sampling

There are no surface water and sediment samples were collected in CY93. However, due to discrepancies identified in the contract laboratory analytical contract, no radiological surface water and sediment sampling data will be presented in the CY93 WIPP ASER. Two years of baseline surface water and sediment analysis data were previously documented in DOE/WIPP 92-037.

1.3.5 Game Animals and Fish Samples

Game animals and fish samples were collected in CY93. However, due to discrepancies identified in the contract laboratory analytical contract, no radiological game animal and fish sampling data will be presented in the CY93 WIPP ASER. Two years of baseline game animal and fish analysis data were previously documented in DOE/WIPP 92-037.

1.4 Nonradiological Monitoring Information

Nonradiological environmental surveillance was also conducted in accordance with the EMP. This program was preceded by the WIPP Biology Program (1975-1982). Six universities participated in this surveillance program. An extensive baseline of information describing the major components of the Los Medanos ecosystem prior to the initiation of the WIPP site construction activities was developed.

A significant portion of the nonradiological surveillance was to document the effect fugitive salt dust generated by the surface stockpiling activities had on the surrounding ecosystem see (Reith et al., 1985). This study is described in the *Summary of the Salt Impact Studies at the Waste Isolation Pilot Plant 1984 to 1990* (DOE/WIPP 92-038).

1.4.1 Meteorology

The WIPP Nonradiological Environmental Surveillance (NES) includes a primary meteorological (MET) station that provides support for various programs at the WIPP. The primary MET function is to generate data to aid in modeling atmospheric conditions for Radiological Environmental Surveillance (RES). The data generated from the meteorological station are wind speed, wind direction, and temperatures at a radius of 3, 10, and 40 meters (10, 30, and 130 feet), respectively, with dew point and precipitation monitored at ground level. These parameters are measured continuously and the data are logged, at fifteen minute intervals, in the Central Monitoring Room.

The annual rate of precipitation at the WIPP site for 1993 was 24 cm (9.4 in), which is 18 cm (7 in) below last year's rate. The annual precipitation for 1993 was 43 percent less than that recorded for 1992.

In CY 1993, the data collected on wind direction in the WIPP area were consistent with data previously collected on wind direction. The wind direction at the WIPP site is predominately from the southeast.

1.4.2 Air Quality Monitoring

Seven pollutant gases are monitored at the WIPP site on a continuous basis. These gases are sulfur dioxide (SO_2), carbon monoxide (CO), ozone (O_3), hydrogen sulfide (H_2S), nitrous oxide (NO), nitrous dioxide (NO_2), and oxides of nitrogen (NO_x). In addition, weekly measurements of Total Suspended Particulates (TSP) are collected by the low-volume continuous air sampler at the far-field air sampling location.

1.4.3 Wildlife Population Monitoring

Population density measurements of birds and small nocturnal mammals are performed annually to assess the effects of WIPP activities on wildlife populations.

Bird Densities

Overall, distribution patterns of species living between WIPP transects and the control transects remain constant with the most significant changes occurring near the facility. More abundant food (i.e., insects drawn to the facility lights) and greater habitat diversity probably account for the increase in the number of species near the WIPP transects compared to those of the control transects. Insect dependant species such as barn swallows, ash-throated flycatchers, and king birds are the prominent species on the increase in the immediate vicinity of the facility. Rock doves, the common city pigeon, have been observed around the WIPP site.

Small Nocturnal Mammal Population Densities

Starting with the outbreak of Hanta virus in the spring of 1993, small nocturnal mammal censuses were conducted on two study plots rather than on the usual four. Midway through the census period there had been outbreaks of the virus in New Mexico and every state bordering New Mexico. The chief vector for the disease had been determined to be the deer mouse, *Peromyscus maniculatus*. To protect researchers from possible exposure, the censuses for Northwest (NW-2) and Control (CT-2) were cancelled. The two censuses that were conducted revealed that the Ord's kangaroo rats remains the most common species encountered in this area. Plains wood rats are the next most common species encountered. Other species encountered in this area are grasshopper mice, white-footed mice, deer mice, and silky pocket mice. A greater number of mammals were captured in the control 1 plot than in the WIPP plot.

1.4.4 Vegetation Monitoring

The CY 1993 vegetation monitoring data show a slight increase of perennial grasses with increasing proximity to the salt tailings. The total coverage of these grasses in all plots was relatively uniform over all distances from the tailings. Although densities of annuals and diversity of species were greater in the control plots, overall, these densities and diversities remained relatively uniform across all plots. A pattern observed from the 1989-1992 data which was also seen in the 1993 data is an increase in shrub cover with increasing proximity to the salt tailings. This increase is a common effect of secondary salination. However, differential effect resulting from salt-induced physiological stress near the salt tailings was not observed. The responses of these plots to higher rainfall in later years will reveal whether this pattern is reflecting the start of significant changes in the structure of the plant community or whether it is only a short-term effect caused by short-term weather conditions. During the study period weather conditions had a uniform effect on vegetation in all plots.

1.5 Quality Assurance

This document adheres to policies set forth by federal Quality Assurance (QA) regulations including: American Society of Mechanical Engineers (ASME) NQA-1, *Quality Assurance Program (QAP) Requirements for Nuclear Facilities* (ASME, 1989) and EPA, QAMS-005/80, *Interim Guidelines and Specifications for Preparing Quality Assurance Project Plans* (EPA, 1980), and fulfills the requirements of the QA plans specified in DOE Orders 5400.1 (DOE, 1988d), 5400.3 (DOE, 1988e), 5700.6C (DOE, 1991) and the *Environmental Regulatory Guide for Radiological Effluent Monitoring and Environmental Surveillance* (DOE/EH-0173T).

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CHAPTER 2

INTRODUCTION

Chapter 2
Introduction

This is the WIPP Annual Site Environmental Report (ASER) for CY93. The purpose of the WIPP as mandated by Public Law 96-164 is to provide a research and development facility to demonstrate the safe disposal of Transuranic (TRU) wastes generated by the defense activities of the U.S. Government. This document is prepared in accordance with the guidance contained in DOE Order 5400.1, *General Environmental Protection Program* (DOE, 1990); DOE Order 5400.5, *Radiation Protection of the Public and the Environment* (DOE, 1990); DOE/WIPP 91-054, *Environmental Protection Implementation Plan*, and DOE/EH-0173T, *Environmental Regulatory Guide for Radiological Effluent Monitoring and Environmental Surveillance*. The above orders require DOE facilities to submit an ASER to the DOE Headquarters Office of the Assistant Secretary for Environment, Safety and Health.

This report provides a comprehensive description of environmental activities at the WIPP during CY93. The requirements and goals driving these activities are more fully described in the *Environmental Monitoring Plan for the Waste Isolation Pilot Plant* (DOE/WIPP 94-024). This plan defines the scope and extent of the WIPP effluent and environmental monitoring programs during the pre-operational and operational life of the site.

This ASER also discusses the QA and Quality Control (QC) programs, which ensure that samples collected and the analytical data obtained are representative of actual conditions at the WIPP site. The EMP is the guidance document that all environmental monitoring programs follow. This guidance document ensures that all appropriate sampling efforts are in place to establish the amount and type of naturally occurring radioactivity in the WIPP area before the WIPP site is operational and to provide data for comparisons between pre-operational and operational environmental conditions once the WIPP site is operating as a waste repository for TRU waste.

The EMP was prepared in accordance with the guidance contained in DOE Order 5400.1 and DOE Order 5400.5. Since waste has not been received, certain elements of DOE Order 5400.1 are not yet relevant to the WIPP environmental monitoring program (i.e., no discussion is included in this report of radionuclide emissions with subsequent calculation of doses to the public).

The EMP is reviewed and updated, as required by DOE Order 5400.1, to address general changes, improvements, and enhancements to be implemented due to experience gained from these monitoring programs.

2.1 Description of the WIPP Project

The WIPP is a project that was authorized by the DOE, National Security, and Military Applications of Nuclear Energy Authorization Act of 1980 (i.e., Public Law 96-164). Its legislative mandate is to demonstrate the safe disposal of radioactive waste resulting from national defense activities and programs. To fulfill this mandate, the WIPP has been designed to perform scientific investigations of the behavior of bedded salt and the interactions between the salt and radioactive wastes and to demonstrate safe and efficient handling, transport, and emplacement of transuranic (TRU) waste in a fully operational disposal site.

The first radioactive wastes will be emplaced once the bench-scale test have been completed at INEL. Once the tests have been successfully completed, wastes will be shipped over a 25-year period to the WIPP site from INEL, Rocky Flats Plant, Hanford Site, Savannah River Plant, Los Alamos National Laboratory, Oak Ridge National Laboratory, Mound Laboratory (operated by Monsanto Research Corporation), Nevada Test Site, Argonne National Laboratory, and Lawrence Livermore National Laboratory for permanent disposal. This TRU waste material is contaminated with alpha emitting radionuclides greater than 100 nCi/g.

Subsequent to a successful completion of the test phase, the WIPP site will be designated as an operational facility and TRU wastes will be transported from generator/storage sites throughout the United States to the WIPP site. This could not happen until the later years of this decade.

The TRU waste to be received from the generator sites will be transported to the WIPP site via tractor-trailer trucks. Each truck can haul up to three TRU Package Transporters (TRUPACT IIs), and each transporter may contain fourteen 55-gallon drums or two standard waste boxes. The TRUPACT II is a durable, reusable container that has been approved by the Nuclear Regulatory Commission (NRC) to transport contact-handled (waste containers that can be handled without shielding) transuranic waste to the WIPP.

Once the TRUPACT IIs have arrived at the WIPP and are transported into the Waste Handling Building, the waste containers will be removed from the TRUPACT IIs, placed on the waste handling hoist, and lowered to the repository level of 655 m (2150 feet) below the surface. During the disposal phase, waste containers will be removed from the hoist and emplaced in excavated storage rooms in the Salado formation, (i.e., a thick sequence of salt beds deposited approximately 250 million years ago in the Permian Age). After the storage areas have been filled, specially designed seals and plugs will be placed in the excavated storage rooms and in the shafts. The plastic

self-healing nature of the salt formation will result in a gradual creep closure, causing encapsulation and isolation of the waste within the Salado formation.

During site operations, the underground area will be ventilated with ambient air that enters the Air Intake Shaft, the Salt Handling Shaft, the Waste Handling Shaft, and exits through the Exhaust Shaft. In the event of an underground accident involving radioactivity, exhaust air can be circulated at a reduced flow rate through the Exhaust Filter Building. This building contains banks of High Efficiency Particulate Air (HEPA) filters that remove potentially contaminated particulates.

2.2 Description of the Environment and Lands

The WIPP site is located in Eddy County in southeastern New Mexico (Figure 2-1). The WIPP site is approximately 40 kilometers (26 miles) east-southeast of Carlsbad, New Mexico, in an area known as Los Medanos (i.e., the dunes). This area is a sparsely inhabited plateau that has little water and limited land uses. Land uses in the surrounding areas include potash mining, oil and natural gas exploration, recreational uses (i.e., hunting, trapping, and birdwatching), and other uses permitted by the BLM.

The WIPP site boundary extends at least 1.6 kilometers or one mile beyond any of the WIPP underground developments and is defined on the surface by the 16-section (4,146 ha) Land Withdrawal Area. On October 30, 1992, the WIPP Land Withdrawal Act, Public Law 102-579, was signed by President Bush transferring the land from the Department of Interior (DOI) to the DOE. A WIPP land management plan, DOE/WIPP 93-004, was then prepared and submitted to Congress in October 1993.

The WIPP site consists of 16 sections (4,146 ha) of federal land in Township 22 South, Range 31 East. Except for the 2.59 square kilometers (one square mile) encompassing the facility known as the DOE exclusive use area, the surface land uses remain largely unchanged. Mining and drilling for purposes other than those which support the WIPP project are restricted within the 16-section (4,146 ha) area.

The WIPP site is divided into zones as represented in Figure 2-1. Zone I is surrounded by a chain-link fence that encompasses all major surface facilities. Zone II is the area that encloses the maximum extent of underground development. The WIPP site boundary provides a functional barrier of intact salt between the underground region defined by Zone II and the accessible environment.

The nearest residents to the WIPP site include eight individuals living at the Mills Ranch, 5.3 kilometers (3.5 miles) south-southwest of Zone 1 of the site, and two individuals living at the Smith Ranch, 11.3 kilometers (seven miles) west-northwest of Zone 1 of the site. Both ranches are continuously monitored as part of the environmental monitoring program. Also included in this monitoring program is the headquarters for the International Minerals and Chemical Corporation Potash Mine, located 14.5 kilometers (nine miles) west-northwest of Zone 1 of the site. Detailed demographic summaries and projections are listed in the *WIPP Final Environmental Impact Statement* (FEIS) (DOE, 1980), the *Final Supplement Environmental Impact Statement* (SEIS) (DOE, 1990), and the *WIPP Final Safety Analysis Report* (DOE, 1990).

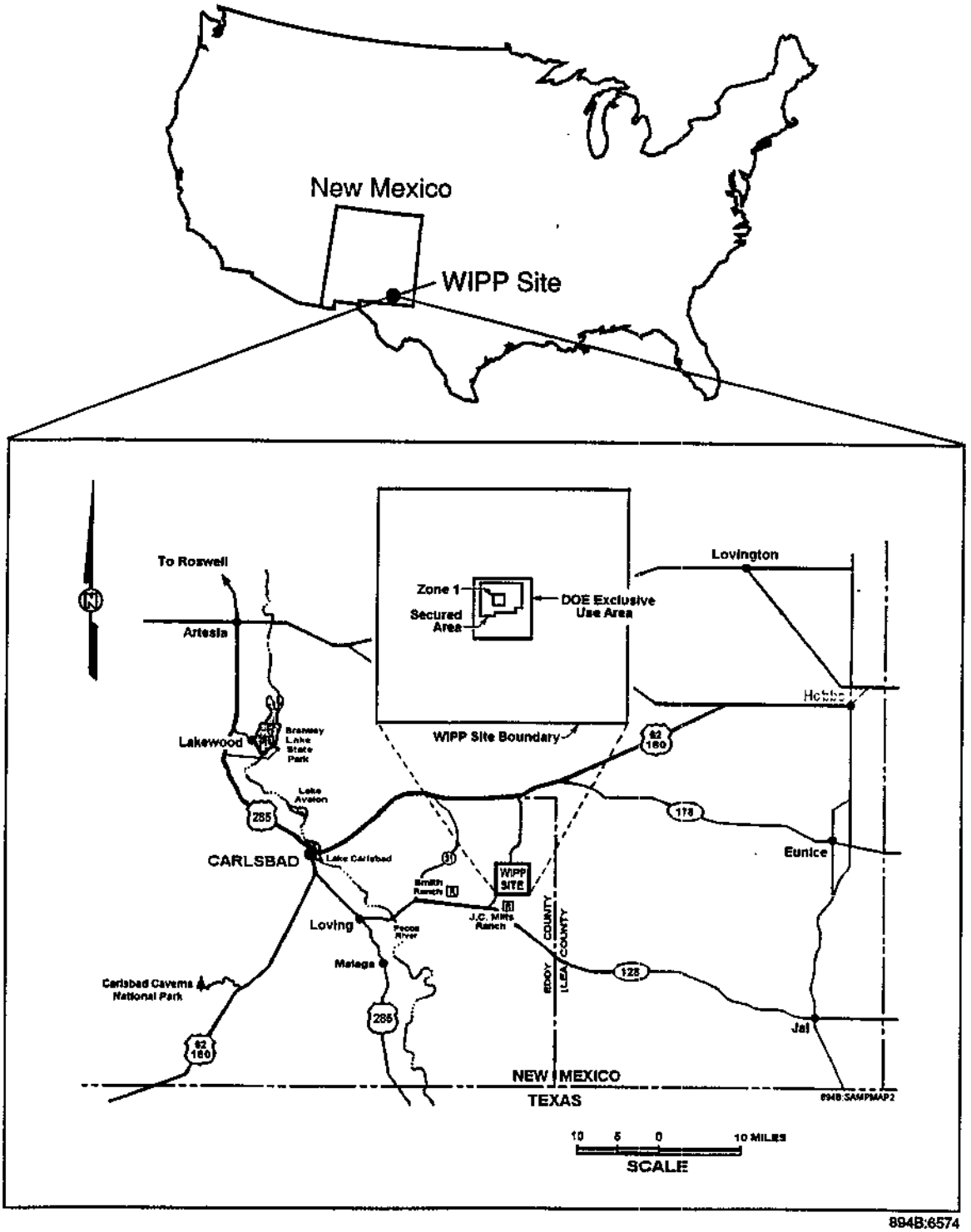

Figure 2-1
Location Of The WIPP Site

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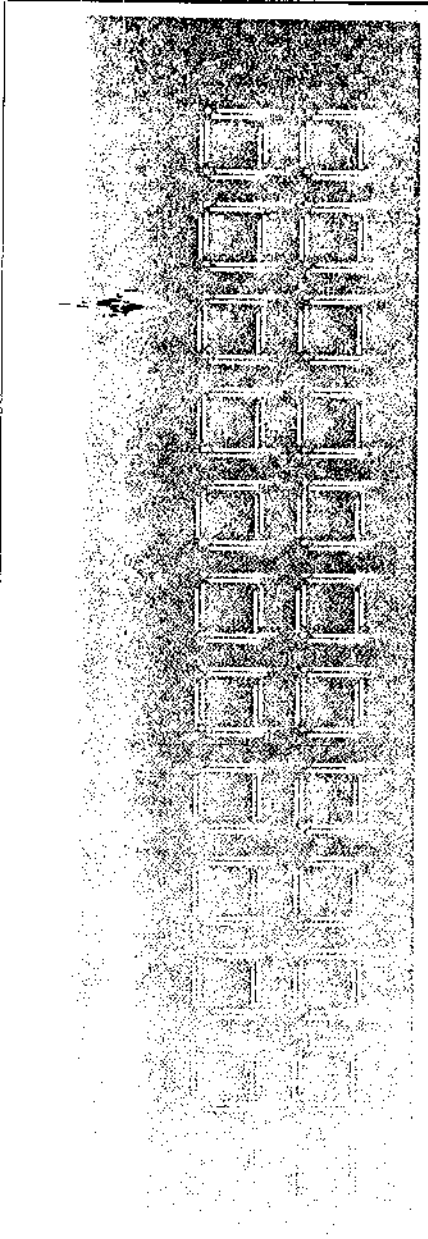

CHAPTER 3

COMPLIANCE SUMMARY

Chapter 3
Compliance Summary

The WIPP is required to comply with all applicable DOE Orders and federal and state laws and regulations. Documentation of required federal and state permits, notifications, and approvals is maintained by the Environment, Safety, Health and Regulatory Compliance (ESH&RC) Department of the Management and Operating Contractor (MOC). Regulatory requirements are implemented by incorporating them into facility plans and procedures.

Table 3-1 provides a summary of the major federal and New Mexico statutes applicable to the WIPP Project. Table 3-2 presents DOE Orders and agreements affecting the WIPP environmental program. Table 3-3 is a summary of agreements between the DOE and the state of New Mexico that affect the environmental program. Table 3-4 details active environmental permits for the WIPP in CY93 and the first quarter of CY94.

3.1 Compliance Assessment for Calendar Year 1993

In 1993 the WIPP remained in compliance with applicable federal and state environmental regulations. Section 3.2 lists the compliance status of each major environmental statute and executive order applicable to the WIPP, including significant issues generated by, and actions and accomplishments driven by these statutes and orders. Section 3.3 describes other significant environmental issues, actions, and accomplishments at the WIPP facility in CY93.

3.2 Compliance Status

This section states the WIPP's status of compliance with the following regulatory requirements.

3.2.1 Atomic Energy Act of 1954 (AEA)
(42 U.S.C. sec. 2011 et seq.)

The AEA establishes a national program for research, development, and utilization of atomic energy for both national defense and domestic civilian purposes. Section 161 (i) (3) of the AEA provides that the Atomic Energy Commission (succeeded by the DOE for national defense purposes) is authorized to prescribe regulations and orders to

> Govern any activity authorized pursuant to this Act [the AEA], including standards and restrictions governing the design, location, and operation of facilities used in the conduct of such activity, in order to protect health and to minimize danger to life or property. . .

The authority of the DOE to develop policies, issue orders, and promulgate regulations (i.e., those addressing environment, safety and health protection aspects) regarding radioactive waste and nuclear materials is derived directly from the AEA. The EPA has also derived its authority to establish standards for the protection of the public and the environment from ionizing radiation from the AEA. The DOE, under the authority of the AEA and in accordance with various Executive Orders (EOs), uses a system of Orders, Notices, and Directives to carry out the mandate to implement effective and consistent programs to protect the public, the environment, and employees from adverse consequences resulting from the DOE operations. Implementation of those Orders, Notices, and Directives dealing with environmental monitoring and surveillance is addressed in the *Environmental Monitoring Plan for the WIPP.*

Most of the waste slated to be sent to the WIPP site is TRU waste. TRU waste contains radioactive components regulated by the AEA and hazardous components regulated by the RCRA. The RCRA contains qualifiying provisions that exclude activities or substances authorized by or regulated under the AEA. Two different sections of the RCRA address these exclusions:

The Solid Waste Exclusion. RCRA sec. 1004(27) defines a solid waste as a . . .*solid, liquid, semisolid, or contained gaseous material resulting from industrial, commercial, mining, and agricultural operations, and from community activities*. . . This definition specifically excludes "source, special nuclear, or by-product material as defined by the Atomic Energy Act of 1954, as amended."

The Inconsistency Exclusion. RCRA sec. 1006(a) provides the following: "Nothing in this Act shall be construed to apply to (or to authorize any State, interstate, or local authority to regulate) any activity or substance which is subject to. . . the Atomic Energy Act of 1954. . . except to the extent that such application (or regulation) is not inconsistent with the requirements of such Acts." [Emphasis added.] Thus, although the WIPP is subject to dual regulation under the AEC and the RCRA, radioactive wastes are principally regulated by the AEC.

3.2.2 Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA)

(42 U.S.C. sec. 9601 et seq.), including the Superfund Amendments and Reauthorization Act of 1986)

The CERCLA, or "Superfund," and the SARA establish a comprehensive federal strategy for responding to, and establishing liability for, releases of hazardous substances from a facility to the environment. Hazardous substance cleanup procedures are specified in the National Contingency Plan (NCP) in Title 40 Code of Federal Regulation (CFR), Part 300. No release sites have been identified at the WIPP that would require cleanup under the provisions of the CERCLA. Any spills of hazardous substances of

reportable quantities must be reported to the National Response Center (NRC) under the provisions of the CERCLA, section 103 and Title 40 CFR, Part 302.

Accidental Releases of Reportable Quantities of Hazardous Substances

During 1993 there were three spills of ethylene glycol in quantities that required reporting. Each spill was less than 1/2 gallon. The reportable quantity for ethylene glycol is one pound. One pound of ethylene glycol is equivalent to approximately one pint of liquid. All three spills were reported to the NRC, the State Emergency Response Commission (SERC), and the Local Emergency Planning Committee (LEPC). A follow-up written report was sent to the SERC and the LEPC. All the spills were immediately contained and cleaned up in accordance with the WIPP spill response procedures. All contaminated soils and spill containment pads were drummed, manifested, and transported to an off-site disposal facility.

The WIPP facility is required to report under Sections 311 and 312 of SARA Title III, also known as the Emergency Planning and Community Right-to-Know Act (EPCRA). Required reports under these two sections are submitted to the SERC, the LEPC, and the local fire department. The WIPP also submits Section 311 data and Section 312 Annual Reports to the Carlsbad Fire Department, the Hobbs Fire Department, and the Otis Fire Department. For emergency response purposes, the DOE maintains Memoranda of Understanding with each of these agencies.

The WIPP facility is currently exempt from reporting under Section 313 of the EPCRA. The items on the toxic chemical list mentioned in Section 313 that are currently in use at the WIPP in amounts meeting the reporting threshold level of 10,000 pounds are ethylene glycol, sulfuric acid, toluene, and xylene. These chemicals are exempted from reporting requirements at this time.

Waste Minimization and Pollution Prevention Awareness Plan

On March 2, 1993, the *WIPP Waste Minimization and Pollution Prevention Awareness Program Plan* was reviewed and accepted by the CAO. This plan will be reviewed annually and updated at least once every three years. Specific guidance for amending the plan will be provided periodically from the DOE; the changes for this year were received in March 1994. The new revision of the *WIPP Waste Minimization and Pollution Prevention Awareness Plan* was completed on May 31, 1994.

3.2.3 Resource Conservation and Recovery Act
(42 U.S.C. sec. 3251 et seq.)

The RCRA was enacted in 1976 and implementing regulations were promulgated in May 1980. This body of regulations ensures that hazardous wastes are managed and disposed of in an environmentally safe manner. Facilities that store, treat, or dispose of hazardous waste also must protect human health and the environment. The Hazardous and Solid Waste Amendments (HSWA) of 1984 restricts the land disposal of hazardous wastes unless certain treatment standards are satisfied. HSWA also places increased emphasis on waste minimization activities and serves as a mechanism to enforce cleanup.

Mixed-Waste Management Test Phase

On July 25, 1990, the state of New Mexico received final EPA authorization to regulate radioactive mixed waste. In a letter dated August 27, 1990, the state of New Mexico notified the WIPP that Parts A and B of the RCRA permit application for the WIPP were due by January 22 and February 28, 1991, respectively. On January 22, 1991, the Part A permit application was delivered to the state and to the EPA Region VI Office in Dallas, Texas (DOE, 1991b). The Part B permit application was delivered to the state on February 26 and to EPA Region VI on February 27, 1991. The DOE-CAO submitted Revision 1 in March 1992. Revision 2 was submitted to the NMED in segments beginning in August 1992. The third revision of the Part B permit application was submitted in January 1993.

The NMED issued a Test-Phase draft permit for the WIPP facility in August 1993 for public comment. In October 1993, the DOE made the decision not to conduct testing of radioactive wastes at the WIPP. Instead, the DOE decided to pursue an accelerated compliance approach in an effort to obtain the necessary permits for permanent waste disposal at the WIPP. At that time the DOE also requested an extension to the public comment period from the NMED. The public comment period was extended until January 15, 1994. The DOE submitted comments to the NMED prior to the January 15 deadline. On January 13, 1994, the DOE formally requested that the NMED allow the DOE to modify the RCRA permit application to reflect disposal, rather than Test-Phase operations.

3.2.4 National Environmental Policy Act
(42 U.S.C. sec. 4321 et seq.)

The NEPA was enacted to require the federal government to use all practicable means to consider potential environmental impacts as part of the decision-making process. The NEPA dictates that the public be allowed to review and comment on proposed projects that might have the potential to significantly affect the environment. The NEPA also directs the federal government to use all practicable means to improve and coordinate federal plans, functions, programs and resources. NEPA contains several "action-forcing" provisions such as:

> Utilizing an interdisciplinary approach in planning and decision making, ensuring appropriate consideration of unquantified environmental values, developing alternatives to proposals involving conflicts over use of resources, making environmental information generally available, and including a "detailed statement" on environmental impacts for "major federal actions significantly affecting the quality of the human environment."

NEPA procedural objectives and public involvement requirements are detailed in the Council on Environmental Quality regulations implementing NEPA in 40 CFR 1500-1508.

To satisfy NEPA requirements, the "Final Environmental Impact Statement" was issued in October 1980 (DOE, 1980), followed by the Record of Decision (ROD) to the FEIS (DOE, 1981), which was published in the *Federal Register* (FR) on January 28, 1981.

The ROD concluded that the Los Medanos (WIPP) site in southeastern New Mexico would be acceptable for the long-term disposal of TRU waste with "minimal risk of any release of radioactivity to the environment." The ROD noted the following:

> If significant new environmental data results [SIC] from the Site Preliminary and Design Validation (SPDV) program or other WIPP project activities, the FEIS will be supplemented as appropriate to reflect such data, and this decision to proceed with phased construction and operation of the WIPP facility will be reexamined in the light of that supplemental NEPA review.

Consistent with this commitment and to further the purposes of NEPA, the DOE issued the "Final Supplement Environmental Impact Statement" in January 1990 (DOE, 1990a) to address changes in the proposed action and the development of new geologic and hydrologic information. These changes included altering the composition of the waste inventory, transporting waste to the WIPP site, conducting a Test Phase, and managing TRU waste mixed with hazardous constituents. The DOE's ROD to proceed with the Test Phase was published on June 22, 1990 (DOE, 1990c).

In accordance with the commitments made in the ROD for the WIPP SEIS, the DOE will issue another SEIS prior to deciding whether to proceed with the Disposal Phase at the WIPP site.

The DOE released DOE Order 5440.1D, *National Environmental Policy Act Compliance Program*, on February 2, 1991. This revision combines a conservative interpretation of the NEPA with a number of new requirements to support direction provided in Secretary of Energy Notice (SEN)15-90. One new requirement was to develop a Mitigation Action Plan (MAP) "for implementation of any commitments

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made in an Environmental I Act Statement (EIS)-ROD for mitigation of environmental impacts associated with an action" (DOE, 1991d, 7[a][23]]. A MAP was prepared based on both RODs and the final was submitted to DOE on July 10, 1991. The commitments described in the MAP will be tracked and reported annually as required by DOE Order 5440.1E (7[a][24]) and *WIPP Annual Mitigation Action Plan Report* (AMR).

DOE Order 5440.1E, *National Environmental Policy Act Compliance Program*, was issued on November 10, 1992, and was updated to meet the final DOE NEPA Rule codified in 10 CFR 1021. This rule revises the provisions of DOE's Guidelines for Implementing the Procedural Provisions of NEPA and consolidates changes required by certain policy initiatives instituted by the Secretary of Energy regarding participation of the public and affected states. The Rule also includes a revised and expanded list of Categorical Exclusions (CXs). CXs are classes of actions that normally do not require the preparation of either an environmental assessment or impact statement.

The WIPP NEPA Compliance Program (consisting of two procedures, a plan, and a training module) has been developed to ensure the requirements of the NEPA are fulfilled at the WIPP site. This program provides NEPA guidance for personnel responsible for the planning, coordination, and performance of work. Adherence to the program ensures that all work performed at the WIPP facility conforms to the provisions of the NEPA. The WIPP NEPA Compliance Program also details the actions taken to evaluate work documents for NEPA compliance in accordance with DOE Order 5440.1E and with 10 CFR 1021.

3.2.5 Clean Air Act (CAA)
(42 U.S.C. sec. 7401 et seq.)

The Clean Air Act provides for the preservation, protection, and enhancement of air quality, particularly in locations of special interest such as areas of natural, recreational, scenic, or historic value. Under Section 109 of the Clean Air Act, the EPA established the National Ambient Air Quality Standards (NAAQS) for six "criteria" pollutants: sulfur dioxide, total suspended particulates, carbon monoxide, ozone, nitrogen oxide, and lead. These standards establish primary and secondary standards for ambient air quality that the EPA judges are necessary to protect public health and welfare.

In 1993, Westinghouse Electric Corporation, Waste Isolation Division, completed the *WIPP Hazardous Air Pollutant (HAP) Emission Inventory* (WP 02-15). The HAPs inventory was developed as a baseline document to calculate maximum potential hourly and annual emissions of both hazardous and criteria air pollutants. The HAPs inventory calculated emissions estimates' for the three CAO locations. These locations include the WIPP site, the CAO located at Greene Street, and the WID Canal Street office.

Emission estimates were used to determine if the WIPP is required to obtain an air permit under state or federal regulations. The HAPs inventory was used to evaluate potential permitting requirements for the following regulations:

- § 112 Clean Air Act National Emission Standards for Hazardous Air Pollutants
- Part C Clean Air Act (Prevention of Significant Deterioration - Criteria Pollutants)
- New Mexico Air Quality Control Regulation 752
- New Mexico Air Quality Control Regulation 702.

Section 112 of the Clean Air Act establishes emission standards for Hazardous Air Pollutants. The 1990 Clean Air Act Amendments (CAAA) increased to 189 the number of hazardous air pollutants regulated under the CAA. Hazardous air pollutant emissions are regulated under 40 CFR 61, the National Emission Standards for Hazardous Air Pollutants (NESHAP). The NESHAP establishes permitting and reporting requirements for facilities that have the potential to emit hazardous air pollutants. At the WIPP, the majority of hazardous air pollutants are regulated in Subpart A of the NESHAP. Radionuclide emissions other than radon are regulated in Subpart H of the NESHAP.

Based on an agreement with EPA Region VI, the DOE has committed to comply with the requirements of 40 CFR 61, Subpart H, through the Disposal Phase of operations at the WIPP. A revised standard for Subpart H radionuclide emissions was promulgated by the EPA in a final rule published in the *Federal Register*, effective December 15, 1989 (54 FR 51654). In the *Final Safety Analysis Report* for the WIPP facility, the doses from future anticipated WIPP facility emissions were calculated to be less than 1 percent of the allowable effective dose equivalent of 10 millirem per year to any one member of the public. The DOE documented the expected emission levels in a data package. This original package was submitted to the EPA in 1990. Additional submittals will be submitted prior to waste receipt. An emissions monitoring system was installed to comply with NESHAPs and to meet periodic confirmatory monitoring compliance requirements. Emissions monitoring test results will be used to verify compliance.

Based on the HAPs inventory, WIPP operations do not exceed the 10 ton-per-year (tpy) emission limit for any individual HAP, or 25-tpy limit for combined HAPs emissions established in Subpart A. Thus, the WIPP does not have any NESHAP Subpart A permitting or reporting requirement at this time. However, 40 CFR 61, Subpart A, §61.09(a)(1), requires that the WIPP facility notify the EPA of its anticipated date of initial startup of the source not more than 60 days nor less than 30 days before that date. In addition, notification of the actual date of initial startup of the source must be made within 15 days after that date.

Based on emission estimates generated in the HAPs inventory, the WIPP site is not required to obtain any federal CAA permits. A federal permit is required if a facility emits 100 tpy of criteria pollutants, 10 tpy of a HAP, or 25 tpy of combined HAPs. In consultation with the NMED Air Quality Bureau, and in conjuction with data collected in the HAPs inventory, the WIPP was required to obtain a New Mexico Air Quality Control Regulation (AQCR) 702 Operating Permit for two back-up diesel generators. A state permit is required when criteria pollutants exceed the state threshold levels of 10 pounds per hour, or 25 tpy. The only emission points where the WIPP site exceeds state threshold criteria is the WIPP back-up diesel generators. On June 18, 1993, the DOE submitted an AQCR 702 permit application for the WIPP back-up diesel generators. The New Mexico Air Quality Bureau issued Air Quality Permit 310-M-2 on December 7, 1993. On February 26, 1994, the WIPP completed the emission monitoring requirements established in the permit. With the submittal of the "Final Compliance Sampling Report" on March 28, 1994, the DOE has fulfilled all monitoring and reporting requirements identified in the permit.

3.2.6 Clean Water Act (CWA)

(or Federal Water Pollution Control Act (FWPCA) of 1972) (33 U.S.C. sec. 1251 et seq.)

Section 402 of the Clean Water Act, the National Pollutant Discharge Elimination System program, establishes the requirements for regulating industrial storm water run off that has the potential to discharge into waters of the United States. The WIPP will demonstrate that the WIPP site prevents the discharge of contaminated storm water through the use of best management practices. These practices include engineering controls, storm water retention basins, the covering of materials storage areas, and the reclamation of disturbed zones.

The WIPP submitted a Notice of Intent to the EPA to obtain a NPDES Storm Water General Permit. On December 31, 1992, the EPA issued a New Mexico NPDES Storm Water General Permit (NMR00A021). As part of the Nationwide General Permit Program, the WIPP is included in the New Mexico General Permit.

The WIPP completed the *WIPP NPDES Storm Water PPP* in March 1993. The NPDES Storm Water Permit rules require that a PPP be developed for each facility covered under the permit by April 1, 1993. The PPP identifies and assesses potential pollutant sources and describes all BMPs that will be implemented to ensure that storm water run off does not contact regulated pollutants. Additionally, the WIPP outlined a schedule for the implementation of all BMPs required to demonstrate compliance with permit requirements.

Approximately 40,000 gallons of nonhazardous brine were generated at the WIPP site each month before the grouting of the Air Intake Shaft (AIS). These waters were generated by seepage between

stratigraphic formations in the ungrouted Air Intake Shaft and from the pumping of observation wells at the WIPP. The permanent disposal/prevention of site-generated brines has been accomplished by the expansion of the WIPP sewage treatment facility and by the grouting of the Air Intake Shaft. The grouting of the AIS began in May of 1993 and was completed in December 1993. This grouting reduced the volume of site-generated brine by approximately 90 percent.

The WIPP has applied for and received an approved Discharge Plan (DP-831) for the WIPP sewage facility. The approved Discharge Plan supersedes the emergency discharge permit of January 1992. Mine water is now collected in portable tanks and is hoisted to the surface where it is pumped to the WIPP site salt pile evaporation basin. Analytical studies have demonstrated that site-generated brines are nonhazardous and can be pumped to the main salt pile evaporation basin for disposal.

The Discharge Plan approves the construction, sampling, and management requirements for the facility. The expansion of the sewerage system was completed in April 1993. This expansion included the construction of a lined evaporation pond divided into two "cells."

The new evaporation pond is located down-gradient of the existing evaporation pond. The south cell of the new pond is used to evaporate sewage effluent only. The north cell is used to evaporate brine waters from mine dewatering and of well water mixed with sewage effluent. Brine waters are hauled to the north cell by water truck and then pumped from the water truck into the north cell. The existing evaporation basin was lined with a 30-mil synthetic liner after the two new cells were brought into operation. The system expansion was completed in April 1993.

3.2.7 Safe Drinking Water Act (SDWA)
(42 U.S.C. sec. 300f et seq.)

The SDWA of 1974 provides the regulatory strategy for protecting public water supply systems and underground sources of drinking water. The New Mexico Environment Department notified the WIPP in a September 9, 1992 letter that the WIPP Public Water Supply has been categorized as a non-transient, non-community system for reporting and testing requirements. The NMED determined that the WIPP is required to sample drinking water for total coliform bacteria, lead, copper, nitrate and nitrite, only.

The city of Carlsbad is contracted to provide raw drinking water to the WIPP from city wells located 31 miles north of the site. Because of this contractual agreement the city of Carlsbad completes the majority of SDWA compliance sampling for the WIPP water system. The city of Carlsbad is considered a community system and is subject to more comprehensive SDWA sampling requirements than WIPP's Non-Community, Non-Transient WIPP water system. WIPP compliance sampling

frequencies are the same as those listed in the table below with the exception of total coliform. Coliform sampling must only be completed quarterly. The sampling requirements for community systems are listed in the following table.

Contaminant	Ground Water
Nitrate	once per year
Nitrite	every three years
Asbestos	every nine years
Arsenic, Barium, Cadmium, Mercury, Chromium, Fluoride, Selenium	every three years
Lead and Copper (for water systems of 501 to 3,300 populations)	initial sampling requires 20 sample sites for two six-month periods beginning on July 1, 1993; requirements may be reduced when action levels are met for two consecutive sampling periods
Synthetic Organics	every three years
Volatile Organics	every three years
Radionuclides	every four years
Turbidity	not required
Total Coliform	once per month

3.2.8 Toxic Substances Control Act (TSCA)

(15 U.S.C. sec. 2601 et seq.)

The TSCA applies primarily to manufacturers, importers, and processors of toxic chemicals for commercial purposes. The WIPP site is not considered a manufacturer or processor of chemical products, and, therefore, most of the provisions of TSCA do not apply. The TSCA regulates the use of Poly-chlorinated Biphenyls (PCBs), asbestos, and materials containing PCBs and asbestos. DOE policy prohibits the use of PCB-containing materials in DOE-installed equipment at facilities like the WIPP site. Therefore, TSCA would not apply to DOE-installed equipment. At the present time, TSCA does not apply to the WIPP repository because there are no plans to ship PCB-contaminated wastes to the WIPP site. The WIPP site will comply with TSCA regulations contained in 40 CFR 761.60 and 761.65 with respect to any possible future storage or disposal of PCB-contaminated materials. Procurement of asbestos containing materials is also prohibited at the WIPP site.

3.2.9 Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA)
(7 U.S.C. sec. 136 et seq).

The FIFRA authorizes the EPA to regulate the registration, certification, use, storage, disposal, transportation, and recall of pesticides. Recommended procedures for storage and disposal of pesticides and pesticide containers are contained in 40 CFR 165. The EPA at its discretion may exempt federal agencies from any FIFRA provisions if emergency conditions exist (40 CFR 166), FIFRA standards are considered mandatory for regular conditions at DOE facilities. DOE will continue to comply with the standards of FIFRA at the WIPP site.

3.2.10 Endangered Species Act (ESA)
(16 U.S.C. sec. 1531 et seq).

The ESA provides protection for threatened or endangered species of flora and fauna. Under Section 7 of the Act and its implementing regulations in 50 CFR 402, the EPA is prohibited from authorizing activities "likely to jeopardize the continued existence of any endangered species or threatened species or result in destruction or adverse modification of habitat of such species. . . The Section 7 process may involve a biological assessment and "formal consultation" followed by the issuance of a . . . *non biological opinion* by the U.S. Fish and Wildlife Service for any species that is determined to be in potential jeopardy. According to the WIPP FEIS (DOE, 1980) and the SEIS (DOE, 1990a), the U.S. Fish and Wildlife Service lists four threatened or endangered species of plants or animals that could occur at the WIPP site. The U.S. Fish and Wildlife Service has determined that WIPP facility activities will have no adverse impacts on these species (Stigman, 1979).

The New Mexico Department of Game and Fish (NMGF), and the U.S. Fish and Wildlife Service also lists 52 possible threatened and endangered species that habitate southeastern New Mexico. No critical habitat for terrestrial endangered species has been identified at the WIPP site (Stigman, 1979). As a result, the U.S. Fish and Wildlife service has not required the WIPP to complete a formal consultation or biological opinion processes under Section 7 of ESA.

3.2.11 National Historic Preservation Act (NHPA)
(16 U.S.C. sec. 470 et seq.)

The NHPA was enacted to protect the nation's cultural resources and to establish the National Register of Historic Places. Since 1976, cultural resources investigations have recorded 98 archeological sites and numerous isolated artifacts within the 16-square-mile area enclosed by the WIPP site boundary. Thirty-three sites are recorded within the central 4-square-mile area, including all of Zones I and II. The sites

are eligible for inclusion in the National Register as an archeological district. Investigations since 1980 have pin pointed an additional 14 individual sites outside the central 4-square-mile area that are considered eligible for inclusion in the National Register (DOE, 1990a). The average archeological site density on WIPP facility lands, according to the WIPP FEIS (DOE, 1980), is 7.5 sites per square mile. A mitigation plan describing the avoidance and/or excavation of sites was submitted to the New Mexico State Historic Preservation Officer (SHPO) (Hart and Brausch, 1980; DOE and BLM, 1983). A determination of "no adverse effect from WIPP facility activities" on cultural resources was made by the SHPO in May 1980 (Merlan, 1980). A similar plan was submitted to the National Advisory Council on Historic Preservation. The Council concurred that the WIPP Mitigation Plan is appropriate to protect cultural resources (National Advisory Council on Historic Preservation, 1981).

Other related legislation affecting WIPP facility lands include the Archeological Recovery Act, which was amended by the Archeological and Historic Preservation Act (AHPA) (16 U.S.C. sec. 469a et seq.). The AHPA requires the preservation of archaeological data affected as a result of any federal or federally related land modification activities. The Archaeological Resources Protection Act (16 U.S.C. 470aa-47011) created improved protection measures for archaeological resources on federal lands and established procedures for federal land managers to issue permits for authorized excavation and removal of archaeological resources.

In accordance with the *WIPP Mitigation Plan*, four archeological sites that could have been or that were actually disturbed by construction activities have been excavated. Avoidance of other archeological sites is carried out by DOE so there will be no adverse effects on known cultural resources from WIPP facility activities. No additional sites have been slated for excavation.

Under the WIPP Land Withdrawal Act, the jurisdiction for managing the cultural resources within the WIPP Site boundary have been transferred to the DOE. A land management plan has been prepared for the WIPP withdrawal area by the DOE in consultation with the BLM and the state of New Mexico. The *Land Management Plan* was issued October 30, 1993. The *Land Management Plan* provides opportunity for participation in the land use planning process by the public and local, state, and federal agencies.

A MOU between the DOE and the BLM is being prepared and should be issued by May 1994. This MOU outlines the responsibilities of each agency with regard to land use management for the withdrawal area, and provides an additional mechanism to protect the withdrawal area from unallowable or inadvertent uses. The *Land Management Plan* and the MOU will serve to provide equitable and consistent administration of archaeological resources within the WIPP withdrawal area.

Prior to disturbing any surface area, WIPP reviews archaeological surveys to determine if the area in question has received an archaeological clearance. If the area has not already received a clearance, a subcontract is issued to a firm providing archaeological resources consulting, and the necessary survey is completed. If archaeological resources are discovered, appropriate mitigating measures are taken.

3.2.12 Floodplain Management
(Executive Order 11988)

EO 11988 directs federal agencies to avoid making modifications that adversely impact floodplains, to consider alternatives to a proposed action, to provide early public review of proposed actions, and to propose mitigation measures for proposed actions within floodplains. Because the WIPP site is not located within a floodplain zone, EO 11988 does not apply to the WIPP facility.

3.2.13 Protection of Wetlands
(Executive Order 11990)

EO 11990 requires that federal agencies consider the effects of proposed actions in wetlands, determine whether wetlands are present, assess the impacts, consider alternatives to a proposed action, provide for early public review, and propose mitigation measures for proposed actions that could affect wetlands. The WIPP facility is neither located within nor will it impact a wetlands area; therefore, EO 11990 does not apply to the WIPP facility.

3.2.14 Environmental Radiation Protection Standards for Management and Disposal of Spent Nuclear Fuel, High-Level and Transuranic Radioactive Wastes
(40 CFR 191)

The authority of the EPA to establish radiation protection standards for nuclear wastes is derived from the Atomic Energy Act, as amended; the Reorganization Plan No. 3 of 1970; and the Nuclear Waste Policy Act (NWPA) (Pub. L. 97-425). Since the mid-1970s, the EPA has been developing guidance and standards for the management and disposal of radioactive wastes. EPA's final rule, 40 CFR 191, was published on September 19, 1985 (50 FR 38066). In a challenge by a coalition of environmental organizations and states, the U.S. Court of Appeals for the First Circuit vacated and remanded 40 CFR 191 to the EPA. The Court found, among other things, that the EPA did not protect groundwater as stringently as provided under the SDWA underground injection provisions [NRDC v EPA 824 F.2d 1258 (1st cir. 1987)]. The Second Modification to the Agreement for Consultation and Cooperation between the DOE and the state of New Mexico dated August 4, 1987, specified that, although the standards were on remand status, the DOE would continue to guide its performance assessment planning efforts as though the vacated regulations were still in effect. In the WIPP Land

Withdrawal Act of 1992 (PL 102-579), Congress reinstated all of the 40 CFR 191, Subpart B regulations with the exception of those that were specifically questioned by the court (i.e., Sections 191.15, Individual Protection Requirements and 191.16, Ground Water Protection Requirements). Congress also required the EPA to issue final disposal regulations by April 30, 1993. On February 10, 1993, the EPA proposed revised disposal regulations under 40 CFR 191, Subpart B (58 FR 7924). On December 20, 1993, the EPA promulgated amendments to the final standard pertaining to individual and groundwater protection requirements (58 FR 66398). The standard applies to facilities regulated by the U.S. Nuclear Regulatory Commission and to facilities under the jurisdiction of the DOE that manage or dispose of spent nuclear fuel, high-level and TRU waste. The standard is divided into three subparts and these are described below.

Subpart A, *Environmental Standards for Management and Storage*, sets the operational term requirements limiting annual doses to members of the public from management and storage operations at disposal facilities. For facilities operated by the DOE and not regulated by the U.S. Nuclear Regulatory Commission, the DOE must provide reasonable assurance that the annual dose to the public in the general environment will not exceed 25 millirem (mrem) to the whole body and 75 mrem to any critical organ. In accordance with DOE policy as delineated in DOE Order 5400.5, the WIPP facility maintains compliance with 40 CFR 191, Subpart A requirements. In the Second Modification to the Agreement for Consultation and Cooperation, DOE agreed with the state of New Mexico that the WIPP facility will comply with the standards of Subpart A upon the initial and future receipt of waste.

Subpart B, *Environmental Standards for Disposal*, establishes several sets of long-term performance requirements for containment and individual protection and provides guidance for their implementation. Of particular significance to the WIPP are the containment provisions of 40 CFR 191.14, which require that radioactive waste disposal systems be designed to provide a reasonable expectation that cumulative releases of radionuclides from the repository over 10,000 years will not exceed levels specified in the standards. This degree of assurance is to be provided by a WIPP performance assessment conducted by the DOE.

Subpart C was established to provide a level of protection for underground sources of drinking water consistent with that provided by regulations implementing the SDWA. EPA believes that compliance with Subpart C of the standard will constitute compliance with the SDWA. Subpart C requires a demonstration that a prospective disposal system will comply for 10,000 years with the primary SDWA regulations for radionuclides. These are the maximum contaminant levels (MCLs) codified in 40 CFR 141.15 and 141.16 that were put into effect on January 19, 1994.

The LWA requires that the EPA must finalize criteria for certifying compliance with 40 CFR 191 by October 1984. These criteria will be codified as 40 CFR 194. Once the EPA establishes these criteria, the DOE will evaluate them as part of its compliance with the 40 CFR 191 disposal standards.

3.2.15 Hazardous Materials Transportation Act (HMTA)
(49 App. U.S.C. sec. 1801 et seq.; 49 CFR 106-179)

The HMTA provides for safe intra- and inter-state transportation of hazardous/nuclear materials. The HMTA allows states to regulate the transport of hazardous/nuclear materials if regulations are consistent with the HMTA or U.S. Department of Transportation (DOT) regulations. The DOT regulations for hazardous/radioactive materials are contained in 49 CFR 171-177. Specifications for the kinds and designs of packages to be used for the transport of various types of radionuclides are contained in 49 CFR 173, Subpart I (and parallel NRC regulations in 10 CFR 71). DOT regulations in 49 CFR 177 provide a routing and quantity rule for highway shipments of radioactive material; 49 CFR 174 contains segregation rules for shipment by rail. In the Second Modification to the Agreement for Consultation and Cooperation dated August 4, 1987, the DOE agreed to comply with all applicable DOT regulations and the corresponding NCR regulations.

3.2.16 Packaging and Transportation of Radioactive Materials
(10 CFR 71)

Regulations for shipping containers and the safe packaging and transportation of radioactive materials are under the authority of the NRC and the DOT. In the Second Modification to the Agreement for Consultation and Cooperation, the DOE agreed to comply with the applicable transportation regulations of the NRC. Packaging requirements for radioactive materials including the Type B packages to be used to transport waste to the WIPP facility are detailed in DOT regulations (49 CFR 173, Subpart I). This references the NRC regulations. The NRC regulations in 10 CFR 71 reference the DOT regulations in 49 CFR 173.

The NRC requirements for shipping containers apply to the certification of the TRUPACT-II shipping container, the container that will be used to transport radioactive waste to the WIPP facility. The TRUPACT-II container was certified by the NRC on August 30, 1989, after compliance with the 10 CFR 71 requirement for Type B packaging was demonstrated (NRC, 1990).

A container supplier inspection was conducted by NRC during the period of January 12-14, 1993. The scope of the audit was to determine whether procedures have been established, documented, and executed at DOE's WIPP facility that meet the quality assurance requirements of 10 CFR 71. The audit also determined whether packages were fabricated and maintained in accordance with the design

approved by the Commission. The NRC had no findings and stated that all quality assurance requirements of 10 CFR 71 were being followed.

3.2.17 Department of Energy National Security and Military Applications of Nuclear Energy Authorization Act of 1980
(Public Law 96-164)

This Act, which authorized the WIPP Project, provides as follows:

> Not withstanding any other provision of law, the Waste Isolation Pilot Plant is authorized as a defense activity of the Department of Energy . . . for the express purpose of providing a research and development facility to demonstrate the safe disposal of radioactive wastes resulting from the defense activities and programs of the United States. . . .

The statute provides for DOE consultation and cooperation with appropriate officials of the state of New Mexico with respect to public health and safety concerns. It also provides for a written agreement between the DOE and the appropriate officials of the state of New Mexico setting forth consultation and cooperation. In compliance, the DOE has entered into two agreements with the state of New Mexico: the Consultation and Cooperation (C&C) Agreement and the Working Agreement for the C&C Agreement. Both agreements have been modified several times (see Table 3-3). The most recent modification of the C&C Agreement is the Second Modification to the Consultation and Cooperation Agreement dated August 4, 1987. The Working Agreement for the C&C Agreement was last modified in March 1988. These agreements are implemented through the DOE and the New Mexico Radioactive Waste Consultation Task Force. In addition, the DOE interfaces regularly with the NMED and the New Mexico Legislature's Radioactive and Hazardous Waste Committee.

3.2.18 Waste Isolation Pilot Plant Land Withdrawal Act
(PL 102-579)

On October 30, 1992, President Bush signed the Waste Isolation Pilot Plant Land Withdrawal Act transferring land from the public domain for use by the Department of Energy (DOE) for the construction, experimentation, operation, maintenance, disposal, shutdown, monitoring, and decommissioning activities at the WIPP. The LWA establishes an extensive regulatory framework that governs the conduct of the WIPP Test Phase and, if all requirements are successfully met, the Disposal Phase.

As a result of the LWA, the Secretary of Energy is required to develop a management plan to provide for grazing, hunting and trapping; wildlife habitat; the disposal of salt tailings; and mining. The *WIPP Land Management Plan* was submitted to Congress in October 1993 and will be maintained throughout the life of the facility, including through decommissioning of the site.

Compliance with the following statutes or regulations is also required under the Act:

- Taylor Grazing Act
- Subchapter IV of the Federal Land Policy and Management Act
- Public Rangelands Improvement Act
- Materials Act of 1947
- Federal Mine Safety and Health Act of 1977
- Solid Waste Disposal Act
- 40 CFR 191
- 29 CFR 1910.120
- Clean Air Act
- Safe Drinking Water Act
- Toxic Substance Control Act
- Comprehensive Environmental Response, Compensation, and Liability Act
- All other applicable federal laws pertaining to public health and safety of the environment.

The law also requires the DOE and the EPA to conform to several requirements prior to initiating both the Test Phase and Disposal Phase, including the EPA's review and approval of key WIPP programmatic documents. Roles and responsibilities for the Department of Interior, the Department of Labor, the Environmental Evaluation Group, the National Academy of Sciences, and the state of New Mexico are defined in the law. A summary of the provisions of the act are as follows:

- The EPA must publish final radioactive waste disposal standards (40 CFR 191).

- The EPA must certify WIPP's compliance with 40 CFR 191, Subparts B and C.

- The EPA must determine that the DOE has complied with the terms and conditions of the NMD issued on November 14, 1990 (55 FR 47700).

- The federal Occupational Safety and Health Administration must certify that it has reviewed the DOE emergency response training programs and has concurred that such programs are in compliance with 29 CFR 1910.120.

NOTE: As defined in the *WIPP Land Management Plan,* the DOE will continue current land management practices and maintain all applicable permits with external organizations.

3.2.18.1 Federal Land Policy and Management Act
(43 U.S.C. secs. 1701-1782)

The Federal Land Policy and Management Act was enacted to ensure, among other things, that

> ". . .public lands be managed in a manner that will protect the quality of scientific, scenic, historical, ecological, environmental, air and atmospheric, water resource, and archeological values; that, where appropriate, will preserve and protect certain public lands in their natural condition; that will provide food and habitat for fish and wildlife and domestic animals; and that will provide for outdoor recreation and human occupancy and use. . ."

Under S. 1671, the Secretary of Energy is required to comply with Subchapter IV of the Federal Land Policy and Management Act. Subchapter IV establishes the authority for grazing fees, range betterment funds, grazing permits, and grazing advisory boards. Under LWA, the Secretary of Energy is empowered to administer these programs.

3.2.18.2 Taylor Grazing Act
(43 U.S.C. sec. 315 et seq.)

This act is intended to prohibit injury to public grazing lands by preventing overgrazing and soil deterioration. The Act promotes the orderly use and/or improvement to public grazing lands by establishing grazing districts and a grazing permit system. As required by the LWA, the DOE must allow grazing to continue on WIPP facility land where grazing districts had been established prior to the date of enactment of the Land Withdrawal Act. The Department of Interior, in consultation with the DOE, will issue grazing permits on WIPP facility land.

3.2.18.3 Public Rangelands Improvement Act
(43 U.S.C. sec. 1901 et seq.)

The Public Rangelands Improvement Act establishes a national policy and commitment to

Inventory and identify current public rangeland conditions and trends.

Manage, maintain, and improve the condition of public rangelands in a manner that they become as productive as is feasible.

Continue the policy of protecting wild free-roaming horses and burros and of removing and disposing of those excess animals that pose a threat to themselves, their habitat, and other rangeland values.

As specified by the LWA, the DOE must administer WIPP facility lands as public rangelands.

3.2.18.4 Executive Order 12548 -- Grazing Fees

EO 12548 orders the establishment of fees for grazing of domestic livestock on public rangelands. The Department of Interior, in consultation with the DOE, will establish grazing fees for WIPP facility lands.

3.2.18.5 Materials Act of 1947
(30 U.S.C. 601 et seq.)

The Materials Act of 1947 pertains to the disposal of mineral materials (e.g., sand, stone, gravel, pumice, cinders, clay and etc.) on public lands. The disposal of vegetative materials (e.g., yucca, manzanita, mesquite, cactus, and timber or forest products) is also addressed. Under the LWA, the WIPP facility must dispose of those salt tailings not used for backfill, in accordance with the bidding, advertising, contract negotiation, and disposition of monies provisions (sections 602-603) of the Materials Act.

3.2.18.6 Federal Mine Safety and Health Act of 1977
(30 U.S.C. sec. 801 et seq.)

Under the Federal Mine Safety and Health Act of 1977, the U.S. Department of Labor (DOL) is responsible for developing and enforcing regulations and standards to protect mine workers. Under a memorandum of understanding between the DOE and the DOL effective July 9, 1987, the Mine

Safety and Health Administration (MSHA) conducts periodic health and safety compliance inspections of WIPP facility underground operations. When the WIPP Land Withdrawal Act was signed into law on July 10, 1993, MSHA became the agency responsible for conducting at least four surface and underground safety inspections per year at the WIPP.

MSHA conducted four inspections during 1993- in January, May, August, and December. The January and August inspections resulted in no surface or underground findings. One minor underground finding occurred during the May inspection, and eight minor surface findings were issued during the December inspection. All minor findings were abated before the MSHA inspector left the facility.

3.2.19 Bald and Golden Eagle Protection Act
(16 U.S.C. secs. 668-668d)

The Bald and Golden Eagle Protection Act makes it unlawful to capture, kill, molest, or disturb these eagles, their nests, or their eggs anywhere in the United States. A permit must be obtained from the U.S. Department of the Interior to relocate a nest that interferes with resource development or recovery operations. The Act potentially applies to the WIPP facility because there is a possibility that these birds could be present on WIPP facility lands.

However, surveys to identify raptor nests on WIPP facility lands since 1985 have thus for failed to locate any bald or golden eagle nests near operational activities. Through the Cooperative Raptor Research and Management Program at the WIPP facility the DOE will continue to monitor for raptor nests on WIPP lands and near operational buildings.

3.2.20 Migratory Bird Treaty Act
(16 U.S.C. sec. 703 et seq.)

The Migratory Bird Treaty Act is intended to protect birds that have common migration patterns between the United States and Canada, Mexico, Japan, and Russia. The Act stipulates that it is unlawful to indiscriminately "kill . . . any migratory bird." It regulates the harvest of migratory birds by specifying the mode of harvest, hunting seasons, and bag limits. Although the WIPP facility is not located within a major migration corridor, there are migratory birds present on WIPP facility lands. As required by the Migratory Bird Treaty Act, the DOE will consult annually with the U.S. Fish and Wildlife Service with respect to impacts on migratory birds from the hunting activities permitted on WIPP facility lands.

3.2.21 Noise Control Act of 1972
(42 U.S.C. sec. 4901 et seq.)

According to the Act's policy clause in section 2(a)(3), the primary responsibility for noise control is vested in state and local governments. Federal regulation is deemed essential only for commercial noise sources requiring national uniformity of treatment (e.g., aircraft noise). However, federal agencies are required to comply with federal, state, interstate, and local requirements respecting control and abatement of environmental noise "to the fullest extent consistent with their authority" [section 4[a] and [b][1], [2]).

DOE facilities are required to comply with the Occupational Safety and Health Administration (OSHA) standards in 29 CFR Part 1910, which include the Occupational Noise Exposure standards in 29 CFR 1910.95. Any WIPP facility noise sources that exceed these standards will be mitigated (e.g., noise dampers have been installed in the WIPP facility underground air exhaust fans). There are no noise sources at the WIPP facility that would affect the general public.

3.2.22 Occupational Safety and Health Administration Regulations
(29 CFR Parts 1900-1999)

Section 6(a) of the Williams-Steiger Occupational Safety and Health Act of 1970 provides that the Department of Labor (DOL) establish employee safety and health standards compatable with those that are commonly practiced in industry and that have been found to meet national consensus standards or established federal standards. DOE complies with OSHA standards and the OSHA safety and health management guidelines for all WIPP facility activities. In addition the WIPP facility has established safety procedures in accordance with DOE policy. The DOE-CAO recently submitted a Voluntary Protection Program (VPP) application to DOE Headquarters.

3.2.23 National Defense Authorization Act - Fiscal Year 1989

The DOE has contracted the New Mexico Institute of Mining and Technology to conduct independent reviews of the health and safety aspects of the design, construction, and operations of the WIPP facility, as required by the National Defense Authorization Act of 1989. The Environmental Evaluation Group (EEG) at the Institute performs the reviews. The DOE will cooperate, as appropriate, with the EEG reviews of health and safety practices at the WIPP facility.

3.2.24 Protection and Enhancement of Environmental Quality
(EO 11514, as amended by EO 11991)

EO 11514 directs federal agencies to

> Monitor, evaluate, and control their activities so as to protect and enhance the quality of the environment.
>
> Review their statutory authority, regulations, policies, and procedures in order to identify any deficiencies or inconsistencies that limit compliance with the NEPA.
>
> Develop procedures to ensure the public is informed of federal programs with environmental impact.
>
> Ensure that information regarding existing or potential environmental problems brought to light by research, development, demonstration, test, or evaluation activities is made available to federal agencies, states, counties, municipalities, institutions, and other appropriate entities.
>
> Comply their statutory authority, regulations, policies, and procedures in order to identify any deficiencies or inconsistencies that limit compliance with the NEPA.

The DOE complies with CEQ regulations and public disclosure requirements by preparing NEPA documentation on WIPP Project activities as necessary. The DOE also conducts continuing comprehensive environmental monitoring programs at the WIPP site.

3.2.25 Federal Compliance with Pollution Control Standards
(EO 12088)

The EO 12088 directs the head of each federal agency to ensure that all necessary actions are taken for the prevention, control, and abatement of environmental pollution. Each agency is responsible for compliance with applicable pollution control standards established by such statutes as the Clean Water Act, the Clean Air Act, the AEA of 1954, and others. Each agency must submit an annual plan for the control of environmental pollution at its facilities. This EO applies to the DOE in controlling pollution at the WIPP facility.

The *Waste Minimization and Pollution Prevention Awareness Plan* was approved by the DOE-WIPP Site Branch (WSB) on March 31, 1993. The plan will be reviewed annually and updated at least every three years. Pollution prevention awareness guidance is contained in the *Resource Conservation and Recovery Act Compliance Manual* (WP 02-6, 02-7) and its implementing procedures, and in the *Environmental Compliance Manual* (WP 02-5). These environmental compliance manuals are currently being revised to incorporate elements of the Waste Minimization and Pollution Prevention Awareness Program.

The WIPP has developed a central inventory database to track the type and quantity of hazardous materials on site. The software to be used for the inventory database was installed in December 1993. Inventory data are now being entered in the database. Once data entry is completed, the inventory will be performed on a monthly basis.

3.3 Other Significant Environmental Issues

An additional Environmental Management Assessment was conducted by EH-24 during the period from July 19 through July 30, 1993. The assessment areas covered and the subsequent WIPP findings are listed:

Organizational Structure	1
Environmental Commitment	None
Environmental Protection Programs	1
Formality of Environmental Programs	3
Internal and External Communications	None
Staff Resources, Training, and Development	1
Program Evaluation, Reporting, and Corrective Action	2
Environmental Planning and Risk Assessment	None
National Environmental Policy Act Programs	1
Total	**9**

Findings resulting from this audit have either been satisfactorily addressed or implementation plans have been developed to address all assessment findings.

Table 3-1
Compliance Status with Major Environmental Regulations Applicable to the WIPP Project

Statute/Regulation	Status
Atomic Energy Act	No radioactive waste was received during CY93.
Clean Air Act	NESHAP data package and letter of notification submitted. No monitoring/reporting required until after receipt of waste.
Clean Water Act	Quarterly inspections of best management practices to comply with (stormwater retention basins) NPDB storm water general permit (NMR00A021)
Comprehensive Environmental Response, Compensation, and Liability Act/Superfund Amendments and Reauthorization Act	No Land Disposal Units (LDUs) exist at the site. No CERCLA site cleanup required. Reports filed as required under SARA for hazardous substances are maintained on site.
Endangered Species Act	Permits to collect biological samples and to band non-endangered species of raptors are obtained.
Federal Land Policy and Management Act	The Land Management Plan was issued October 30, 1993, as required by the WIPP Land Withdrawal Act. A MOU between the DOE and the BLM should be issued by May 1994. This MOU outlines the responsibilities the BLM and the DOE have with regard to land use management for the withdrawal area.
Federal Insecticide, Fungicide, and Rodenticide Act	All use of pesticides is approved by Industrial Safety and is performed by subcontractors.
Hazardous Materials Transportation Act	Hazardous wastes to be sent off site are reviewed to ensure compliance with HMTA.
National Environmental Policy Act (as supplemented by DOE Order 5440.1E, National Environmental Policy Act Compliance Program)	Mitigation Action Plan was prepared based on the RODs to the two WIPP EISs. Annual Mitigation Reports are prepared each year to status the commitments made in the RODs. All WIPP activities subject to the NEPA under DOE Order 5440.1E are reviewed and the appropriate NEPA documentation is filed with the DOE- CAO.
National Historic Preservation Act	See "New Mexico Cultural Properties Act."
*New Mexico Air Quality Control Act	New Mexico does not yet have primacy for NESHAP for radionuclide emissions from DOE facilities.

Table 3-1
(continued)
Compliance Status with Major Environmental Regulations
Applicable to the WIPP Project

Statute/Regulation	Status
New Mexico Hazardous Waste Management Regulations	See "Resource Conservation and Recovery Act." NMED does not yet have primacy for all areas by the RCRA.
New Mexico Radioactive Materials Act	No radioactive wastes had been received at the WIPP by the end of CY93.
*New Mexico Water Quality Act	The DOE submits quarterly discharge monitoring reports to the NMED Groundwater Quality Bureau to comply with the requirements of the WIPP Discharge Plan, DP-831.
New Mexico Wildlife Conservation Act	See "Endangered Species Act."
Resource Conservation and Recovery Act	*Hazardous-waste generator compliance:* All site-generated hazardous wastes were transported off-site within the 90-day accumulation period. *No-Migration Determination compliance:* The third annual report was submitted to EPA on November 9, 1993. *Mixed-waste management:* Revision 3 of the Part B permit application was submitted to the NMED January 1993. The draft permit was issued by the NMED on August 24, 1993. *Underground Storage Tanks:* Annual registration fee paid. Maintenance of inventory control records continues.
Toxic Substances Control Act	Procurement of asbestos-/PCB-containing materials not allowed. Other portions of TSCA not applicable.

Table 3-2
DOE Orders and Agreements Affecting the WIPP Environmental Program

ORDER NO.	DATE	TITLE	ANNOTATION
DOE 5400.1	11/09/88 Change 1- 06/29/90	General Environmental Protection Program	Establishes environmental protection program requirements, authorities, and responsibilities for DOE operations for ensuring compliance with federal and state environmental protection laws and regulations, federal executive orders, and internal department policies.
DOE 5400.2A	01/31/89	Environmental Compliance Issue Coordination	Establishes DOE requirements for coordination of significant environmental compliance issues.
DOE 5400.3	02/22/89	Hazardous and Radioactive Mixed Waste Program	Establishes DOE hazardous and radioactive mixed waste policies and requirements for RCRA compliance.
DOE 5400.4	10/06/89	Comprehensive Environmental Response, Compensation, and Liability Act Requirements	Establishes basic requirements for implementation of the Superfund at DOE facilities.
DOE 5400.5	02/08/90 Change 2- 01/07/93	Radiation Protection of the Public and the Environment	Establishes standards and requirements for operations of the DOE and DOE contractors with respect to protection of the public and the environment against undue risk from radiation.
DOE 5440.1E	11/10/92	National Environmental Policy Act	Establishes DOE policy for implementation of the National Environmental Policy Act of 1969 (PL 91-190).
DOE 5480.1B	03/27/90 Change 5- 05/10/93	Environmental Protection, Safety and Health Protection Program for DOE Operations	Establishes and overall framework of program requirements for safety, environmental, and health protection.
DOE 5480.3	07/09/85	Safety Requirements for the Packaging of Fissile and Other Radioactive Materials	Establishes requirements for packaging and transportation of radioactive materials for DOE facilities.
DOE 5484.1	02/24/84 Change 7- 10/17/90	Environmental Protection, Safety, Health Protection Information Reporting Requirements	Establishes requirements and procedures for reporting information having environmental protection, safety, or health significance to DOE operations.
AL 5484.1	08/23/82 Change 1- 10/24/86	Environmental Protection, Safety and Health Protection Information Reporting Requirements	Albuquerque Operations Office implementation of 5484.1.

Table 3-2
(continued)

DOE Orders and Agreements Affecting the WIPP Environmental Program

ORDER NO.	DATE	TITLE	ANNOTATION
DOE 5480.23	04/30/92	Nuclear Safety Analysis Reports	To establish uniform requirements for the preparation and review of safety analyses of DOE operation s which include the following: identification of hazards, their elimination or control, assessment of the risk, and documented management authorization of their operation.
DOE 5482.1B	9/23/86 Change-5 05/10/93	Environmental, Safety and Health Appraisal Program	To establish the Environmental Protection, Safety, and Health (ES&H) appraisal program for the DOE.
DOE 5500.3A	04/30/91 Change 1- 02/27/92	Planning, and Preparedness, for Operational Emergencies	To establish requirements for the development of DOE site-specific emergency plans and procedures for radiological emergencies occurring in existing or planned DOE reactors and non-reactor nuclear facilities. It also requires that comprehensive emergency actions are planned, coordinated, and implemented to respond effectively to the on-site and off-site consequences of a radiological emergency at these facilities, and it provides for appropriate coordination between DOE and off-site officials to ensure the protection of on-site personnel, public health and safety, and the environment.
DOE 5700.6C	08/21/91	Quality Assurance	To provide DOE policy, set forth principles, and assign responsibilities for establishing, implementing, and maintaining programs of plans and actions to ensure quality achievement in DOE programs.
DOE 5820.2A	09/26/88	Radioactive Waste Management	Establishes policies and guidelines by which DOE manages radioactive waste, waste byproducts, and radioactively contaminated surplus facilities.
DOE 6430.1A	04/06/89	General Design Criteria	To provide general design criteria for use in the acquisition of DOE facilities and to establish responsibilities and authorities for the development and maintenance of these criteria.

Table 3-3

Summary of Agreements Between the DOE and the State of New Mexico That Affect the WIPP Environmental Program

Stipulated Agreement on Civil Action No. 81-0363 JB - This agreement, approved by the U.S. District Court proceedings, held in abeyance in the lawsuit against the DOE by the state of New Mexico, was executed on July 1, 1981. The eight-page agreement assures that a binding, enforceable "consultation and cooperation" agreement will be entered into by the DOE and the state, and that the DOE will make a "good faith effort" to resolve certain state off-site concerns (which are covered in the Supplemental Stipulated Agreement). The Stipulated Agreement also addresses a number of additional studies and experiments to be conducted by the DOE for the Site Preliminary and Design Validation Phase of the WIPP facility. This agreement was signed by Jeff Bingaman (Attorney General, state of New Mexico) and Myles Flint (Attorney, U.S. Department of Justice), and was issued July 1, 1981, by Juan G. Burciaga (U.S. District Judge, District of New Mexico).

Agreement for Consultation and Cooperation – Usually referred to as the "C&C Agreement," this agreement is contained in Appendix A to the Stipulated Agreement. It affirms the intent of the Secretary of Energy to consult and cooperate with New Mexico with respect to state public health and safety concerns. It was signed in July 1981 by Bruce King (Governor, State of New Mexico) and James B. Edwards (Secretary, U.S. Department of Energy).

Working Agreement for Consultation and Cooperation, Appendix B, Article IV, Revision I – This agreement, Appendix B to the Stipulated Agreement, identifies in Article IV over 60 "key events" and "milestones" in the construction and operation of the WIPP facility that must be reviewed by the state before they are commenced. Many environmental items are included. It was signed in March 1983 by Robert McNeill (Chairman, Radioactive Waste Task Force), and R. G. Romotowski, (Manager, Albuquerque Operations Office, U.S. Department of Energy). (Article IV of the Working Agreement was revised on April 8, 1983).

Supplemental Stipulated Agreement Resolving Certain State Off-Site Concerns Over WIPP – This agreement dated December 27, 1982, addresses five state concerns including the need for state "verification" of the WIPP Environmental Monitoring Program. The concerns addressed are: state liability for a nuclear incident, emergency response preparedness, transportation monitoring of the WIPP facility waste, the WIPP facility environmental monitoring by the state, and upgrading of state highways. It was signed in December 1982 by Bruce King (Governor, State of New Mexico) et al., and R. G. Romotowski (Manager, Albuquerque Operations Office, U.S. Department of Energy).

First Modification to the July 1, 1981, Agreement for Consultation and Cooperation on WIPP by the State of New Mexico and the U.S. Department of Energy – This modification was signed November 30, 1984, wherein the DOE and the state agree to address certain concerns of the state regarding: (1) the specific mission of the WIPP Project, (2) a demonstration of retrievability prior to waste emplacement, (3) post-closure control and responsibility, (4) completion of certain additional scientific testing and reports, (5) compliance with applicable federal regulatory standards for waste repositories, and (6) a program for encouraging and reporting on the hiring of New Mexico residents at the WIPP Project. It was signed in November 1984 by Joseph Goldberg (Secretary, Health and Environment Department, State of New Mexico), and R. G. Romotowski (Manager, Albuquerque Operations Office, U.S. Department of Energy).

Second Modification to the July 1, 1981, Agreement for Consultation and Cooperation on WIPP by the State of New Mexico and the U.S. Department of Energy – Signed August 4, 1987, wherein theDOE and the state agree to address certain concerns of the state regarding: (1) surface and subsurface mining and drilling after closure of the WIPP site, (2) the disposal of salt tailings at the WIPP site, and (3) compliance with U.S. Environmental Protection Agency, U.S. Department of Transportation, and U.S. Nuclear Regulatory Commission regulations. It was signed in August 1987 by Garrey Carruthers (Governor, State of New Mexico) et al., and R. G. Romotowski, (Manager, Albuquerque Operations Office, U.S. Department of Energy).

Table 3-3
(continued)
Summary of Agreements Between the DOE and the State of New Mexico that Affect the WIPP Environmental Program

1988 Modification to the Working Agreement of the Consultation and Cooperation Agreement Between the U.S. Department of Energy and the State of New Mexico on the Waste Isolation Pilot Plant – This modification deleted the sorbing tracer test from the list of required reports and substituted additional tests. In addition, the state is allowed to operate a fixed-air sampler in the mine ventilation effluent air stream. It was signed in March 1988 by Kirkland Jones (Deputy Director, New Mexico Environmental Improvement Division, State of New Mexico) et al., and R. G. Romotowski (Manager, Albuquerque Operations Office, U.S. Department of Energy).

Environmental Oversight and Monitoring Agreement – This agreement states that the DOE will provide additional technical and financial support for state activities in environmental oversight, monitoring, access, and emergency response to ensure compliance with applicable federal, state, and local laws at several DOE facilities including the WIPP facility. It was signed in October 1990 by Garrey Carruthers (Governor, State of New Mexico; Dennis Boyd (Secretary, Health and Environment Department), and Bruce G. Twining (Manager, Albuquerque Operations Office, U.S. Department of Energy).

Site-Specific Protocol for Implementation of the Environmental Oversight and Monitoring Agreement – Signed October 23, 1992, this protocol describes the site-specific protocol for day-to-day activities involving NMED and DOE contract personnel stationed at the WIPP. This protocol is a result of the "Environmental Oversight and Monitoring Agreement of 1990" between the State of New Mexico and the DOE. It is designed within the context of the unique nature and purpose of the WIPP.

Table 3-4
Active/Pending Permits for the Waste Isolation Pilot Plant During 1993

Granting Agency	Type of Permit	Permit Number	Granted/ Submitted	Expiration	Permit Status
Department of the Interior, Bureau of Land Management	Right-of-Way for Water Pipeline	NM53809	8/17/83	None	Active
Department of the Interior, Bureau of Land Management	Right-of-Way for the North Access Road	NM55676	8/24/83	None	Active
Department of the Interior, Bureau of Land Management	Right-of-Way for Railroad	NM55699	9/27/83	None	Active
Department of the Interior, Bureau of Land Management	Right-of-Way for Dosimetry and Aerosol Sampling Sites	NM63136	7/31/86	None	Active
Department of the Interior, Bureau of Land Management	Right-of-Way for Seven Subsidence Monuments	NM65801	11/7/86	None	Active
Department of the Interior, Bureau of Land Management	Right-of-Way for Aerosol Sampling Site	NM77921	8/18/89	8/18/2019	Active
Department of the Interior, Bureau of Land Management	Right-of-Way for Ten Raptor Nesting Platforms	NM82212	9/12/89	12/13/2019	Active
Department of the Interior, Bureau of Land Management	Right-of-Way for Survey Monument Installation	NM82245	12/13/89	12/13/2019	Active
Department of the Interior, Bureau of Land Management	Approval to Drill 2 New Test Wells on Existing Pads at P-1 and P-2	None	9/18/86	None	Active
Department of the Interior, Bureau of Land Management	Free Use Permit for Caliche	NM-FU3-91183	8/18/93	8/18/94	Active
New Mexico Environment Department	Open Burning Permit to Train Fire Control Crews	None	5/3/93	5/3/94	Active
New Mexico Environment Department	Operating Permit for two Backup Generators	310-M-2	12/7/93	None	Active

Table 3-4
(continued)
Active/Pending Permits for the Waste Isolation Pilot Plant During 1993

Granting Agency	Type of Permit	Permit Number	Granted/ Submitted	Expiration	Permit Status
New Mexico Environment Department	Submittal of Part B RCRA Permit Application		Submitted to the NMED and EPA Region VI on 2/26/92 and on 2/27/92. Revisions were delivered to the NMED on 3/4/92 and 1/27/93.		NMED declared permit administratively complete 7/22/92. Draft permit issued 8/24/93. Public comment period was held open to 7/14/94.
New Mexico Environment Department	Acknowledgement of Notification of Hazardous Waste Activity	NM48901 39088	1/88 Latest report delivered on 2/28/92	None - Contingent upon delivery of biennial report	Active
New Mexico Department of Game and Fish	Individual Banding	1961	4/2/93	3/31/94	Active
New Mexico Department of Game and Fish	Master Collecting	1894	4/1/93	3/31/94	Active
New Mexico Department of Game and Fish	Concurrence that WIPP construction activities will have no significant impact on State-listed threatened or endangered species	None	5/26/89	None	Active
U.S. Department of the Interior, Fish and Wildlife Service	Master Personal Banding	22478	5/19/93	6/30/95	Active
U.S. Department of the Interior, Fish and Wildlife Service	Concurrence that WIPP construction activities will have no significant impact on Federally-listed threatened or endangered species	None	5/29/80	None	Active

Table 3-4
(continued)
Active/Pending Permits for the Waste Isolation Pilot Plant During 1993

Granting Agency	Type of Permit	Permit Number	Granted/ Submitted	Expiration	Permit Status
New Mexico Department of Finance and Administrative Planning Division, Historic Preservation Bureau	Concurrence that the DOE Archaeological Resources Protection Plan is adequate to mitigate any adverse impacts upon cultural resources resulting from construction of the WIPP facility	None	7/25/83	None	Active
U.S. Environmental Protection Agency	Notification of the presence of 2 Underground Storage Tanks	None	4/15/86	None	Active
U.S. Environmental Protection Agency	New Mexico NPDES Storm Water General Permit	NMR00 A021	12/31/92	12/31/97	Active
New Mexico Commissioner of Public Lands	Right-of-Way for High Volume Air Sampler	RW-22789	10/3/85	10/3/2020	Active

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CHAPTER 4

ENVIRONMENTAL PROGRAM INFORMATION

Chapter 4
Environmental Program Information

The WIPP's policy is to conduct its operations in a manner that complies with all applicable environmental laws and regulations.

4.1 Environmental Monitoring Plan

The WIPP Environmental Monitoring Plan outlines a program that monitors a comprehensive set of parameters that detect and quantify present and potential future environmental impacts. Nonradiological portions of the plan focus on the immediate area surrounding the site.

The goal of the EMP is to determine whether there are impacts during the preoperational phase of WIPP on the local ecosystem. Evaluation of the severity, geographic extent, and environmental significance of these impacts is important to future research and the mission of the facility. Although the WIPP has performed a detailed study of these impacts, additional samples will be collected and analyzed to investigate and explain trends or anomalies that may have a bearing on environmental impacts.

As recommended in DOE/EP-0023 (i.e., Corley et al. 1981) and DOE/EH-0173T, the EMP monitors levels of naturally occurring radionuclides. This surveillance includes the monitoring of world-wide fallout and those expected in the WIPP waste. The geographic scope of radiological sampling is based on projections of potential release pathways (see Figure 5-1, Primary Pathway Exposure) and those in WIPP waste. The surrounding population centers are also monitored as sampling devices.

As required by DOE Order 5400.1, the EMP is to be reviewed annually and updated every three years. The most recent EMP was updated in March 1994 (DOE/WIPP 94-024).

4.2 Baseline Data

Within the WIPP Environmental Monitoring section there are four programs currently in place, the NES, the RES, the Cooperative Raptor Research, and the WIPP Groundwater Surveillance Programs. Their purpose is to collect the data needed to detect and quantify possible impacts that construction and operational activities at the WIPP may have on the surrounding ecosystem.

Preliminary studies must be taken into effect when considering the WIPP environmental monitoring efforts because they contribute to the baseline data during the construction phase and are the predecessors to the long-term monitoring programs. These studies are:

- WIPP Site Characterization Program - instituted in 1976 by Sandia National Laboratories (SNL) to monitor air quality, background radiation levels, and groundwater quality (Pocalujka et al., 1979; 1980a, b, c; 1981a, b; Powers et al., 1978; Lappin, 1989).

- WIPP Biology Program - began in 1975 with baseline studies of climate, soils, vegetation, arthropods, and vertebrates (Best, 1980).

- Investigations of the site geohydrology - conducted by the U.S. Geological Survey (USGS) at the request of the DOE. In addition, the NRC issued a contract to Columbia University to perform a study of radionuclide mobility in the highly saline groundwaters of the Delaware Basin (USGS, 1983).

- Radiological monitoring of air, water, and biological media - conducted by the Atomic Energy Commission (ACE) before and after the Project Gnome nuclear detonation (U.S. AEC, 1962a, b, c, d).

4.3 Environmental Monitoring and Planning Activities

This section addresses significant environmental activities that occurred during CY93.

4.3.1 Waste Minimization Committee

A Waste Minimization Committee was formed of representatives from groups generating or working with hazardous and/or large volumes of waste. The Committee prepared a Waste Minimization Charter, which outlines the Committee's responsibilities.

The Waste Minimization Committee began a white bond paper and aluminum can recycling project on December 1, 1993. Various employee incentives are being used to promote these recycling programs. The WIPP site has been recycling approximately 3 tons of paper and 50 pounds of cans per month since this project began.

Other waste minimization activities for 1993 include:

- Off-site recycling of approximately 2,100 gallons of waste oil
- Reuse of cold-degreasing solvents at 6 solvent stations used for cleaning parts
- Off-site reclamation of 600 gallons of cold-degreasing solvents
- Substitution of nonhazardous for hazardous materials
- Exclusive use of recycled janitorial paper products
- Off-site recycling of approximately 150 lead-acid batteries

On February 18, 1993, the WIPP completed the annual waste reduction report required by DOE Order 5400.1 and SEN 37-92. This report delineates waste reduction activities conducted at the WIPP in CY93.

4.3.2 Environmental Training

Environmental training was provided to those personnel associated with environmental operations at the WIPP. Training courses ranged in content from technical topics (e.g., the RCRA), to basic ES&H training. These courses were conducted both on-site by WIPP personnel and off-site by various contractors. Four people attended a six-week in-depth study of environmental compliance issues relevant to the DOE at the Environmental School of Excellence.

4.3.3 WIPP Land Management Plan

On October 30, 1992, WIPP Land Withdrawal Act (i.e., Public Law 102-579) was signed into law. The WIPP Land Withdrawal Area is comprised of 10,240 acres that have been transferred from the Department of Interior to the Department of Energy.

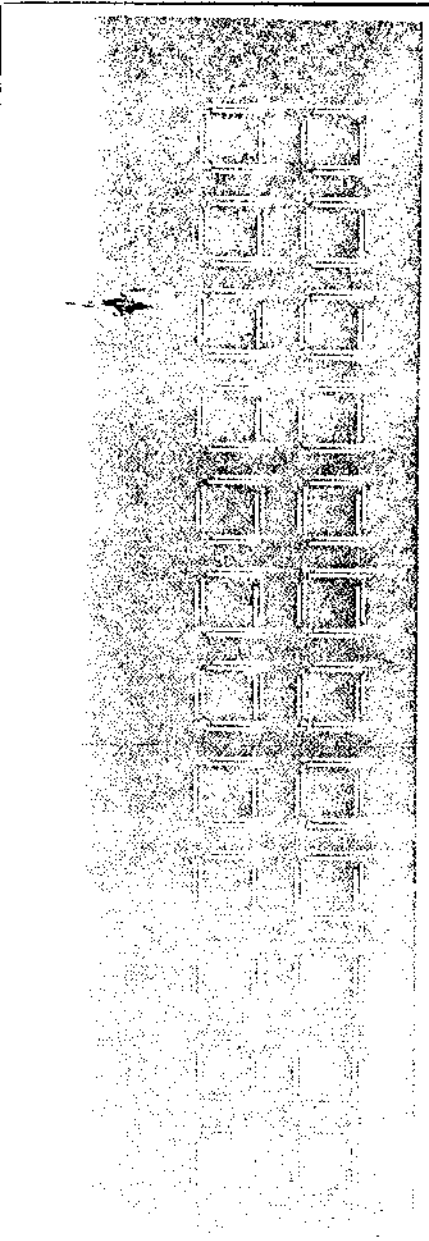
One requirement of the Act is the preparation of a land management plan. The WIPP site *Land Management Plan* completed in October 1993 fulfills this requirement. This plan has been drafted by the DOE and the BLM in consultation with the state of New Mexico. This land management plan assures that future management of the withdrawal area will be consistent with the Federal Land Policy Management Act (FLPMA), the WIPP Land Withdrawal Act, and other applicable laws. The term of this land management plan is through the decommissioning phase of the WIPP facility. A separate plan for the post-commissioning phase is required by the Act and will be prepared at a later date.

Management Goal

The goal of the Land Management Plan is to manage the withdrawal area as it has been traditionally managed and to avoid, whenever possible, placing restriction on land use. It is not the intent of the

DOE to make the withdrawal area an exclusive-use area. However, some restrictions are needed to protect the long-term integrity of the WIPP repository. During operations, the safety and security of the facility must be maintained. The Act gives the DOE the authority to restrict activities in the withdrawal area to whatever extent it deems necessary to ensure the protection of the facility, the staff, and the public.

As a complement to this land use plan, a MOU shall be executed between the DOE and the BLM as required by the Act. This MOU will outline responsibilities of each agency with regard to requests for the use of the withdrawal area. This MOU will also define the consultation role of other land management agencies adjacent to and in the vicinity of the withdrawal, (including the state of New Mexico and other federal agencies).



CHAPTER 5

ENVIRONMENTAL RADIOLOGICAL PROGRAM INFORMATION

Chapter 5
Environmental Radiological Program Information

The following subsections provide a description of the various radiological programs constituting the EMP at the WIPP. The media that are analyzed radiologically are airborne particulates, soil, surface water, groundwater, and biotics. Parameters analyzed are in the primary pathway exposure model which could possibly influence the dose to man.

5.1 Radioactive Effluent Monitoring

The Radioactive Effluent Monitoring Program is described in the EMP. This plan defines the scope of the WIPP effluent and environmental monitoring programs during the operational life of the facility as indicated in Figure 5-1, Primary Pathways To Man For Radioactive Releases From The WIPP Site.

The Environmental Regulatory Guide for Effluent Monitoring and Environmental Surveillance (DOE/EH-0173T), (DOE, 1991), requires that monitoring of liquid waste effluent streams be adequate to demonstrate compliance with dose limits in DOE Order 5400.5, *Radiation Protection of the Public and the Environment* (DOE, 1990). This order also requires that potential sources of contaminated airborne emissions be monitored. In CY93 no radioactive waste was received at the WIPP site, so no effluent sampling or release data are reported in this document.

5.2 Environmental Radioactivity Monitoring

The following subsections present the monitoring results of the EMP for CY93. These results include those for monitored subprograms such as aerosols, ambient radiation, terrestrial radioactivity, hydrologic radioactivity, and biotic radioactivity. It should be noted that in this report no off-site radiological analytical data are presented. The contract laboratory that was awarded the 1993 radiological analytical contract was unable to meet the terms of the contract. Upon a review of the data submitted and an evaluation of the laboratory's performance, the WIPP decided to cancel the contract. Thus, no data concerning subprogram monitoring will be included in this report. Aggressive steps have been taken at the WIPP to issue another contract for radiological analytical services. It is expected that all environmental media sampled in 1994 will have associated data presented in the WIPP 1994 ASER. However, it should be noted that gross alpha and beta analysis of the air filters was conducted at the WIPP Low Level Counting Lab.

The *Statistical Summary of the Radiological Baseline Program for the WIPP* (DOE/WIPP 92-037) provides an in-depth analysis of radiological data collected to meet the requirements of DOE Order 5400.1.

5.2.1 Atmospheric Radiation Baseline

Continuous particulate aerosol samplers operate at eight locations, three within 1000 meters of the facility, four at local ranches and communities, and one as a sample control site (Figure 5-2). The continuous aerosol samplers presently in use maintain a regulated flow rate of approximately 950 milliliters per second (two cubic feet per minute) of air through a 47-millimeter (1.9-inch) glass fiber filter. Table 5-1 lists the 1993 quarterly average concentrations of the alpha and beta activity on the low-volume aerosol filters from each location.

Airborne particulate sampling was initiated in July 1985 at a few locations. Routine weekly filter collections and subsequent radiochemical analyses began in early 1986, except for in the Far Field location where data collection began in October 1986. Particulate filters were collected weekly at all locations in CY93. These filters were analyzed at the Environmental Low-Level Counting Lab at the WIPP where a weekly gross alpha and beta count of each filter was completed.

Figure 5-3 shows the mean gross alpha concentrations for all eight sampling locations. The mean gross alpha concentrations in Figure 5-3 show limited fluctuation throughout the year and range from 1.26 E-10 to 5.22 E-10 Bq/ml. These fluctuations appeared to be consistent among all sampling locations.

The mean gross beta concentrations in Figure 5-3 fluctuate throughout the year within the range of 1.23 E-09 to 9.74 E-10 Bq/ml. The individual gross alpha and beta concentrations reported for each location are documented in Appendix 1.

Gross alpha and beta measurements provide an indication of naturally occurring radionuclide concentrations or changes in a specific radionuclide concentration. These measurements are screened to ensure that important radionuclides are not overlooked when measurements are performed.

5.2.2 Ambient Radiation Baseline

A Reuter-Stokes High Pressure Ionization Chamber designed to monitor low levels of gamma radiation in the environment was put into operation in May 1986. This unit is located at the WIPP far field location, which is 1000 meters northwest of the site. The detector used to measure low levels of gamma radiation, a pressurized ion chamber, measures levels of radiation from 1 to

100 microroentgen per hour (μR/hr). Using the average rate of 7.4 μR/hr, the estimated annual dose is approximately 65 millirem. The fluctuations noted are primarily due to calibration of the system and meteorological events (e.g., the high intensity thunderstorms that frequent this area in late summer).

A seasonal drop in ambient radiation has been observed in the first and fourth quarters of each year. As stated in previous reports, this fluctuation may be due to variations in the emission and dispersion of Radon-222 from the soil around the WIPP site. These variations can be caused by meteorological conditions, (i.e., inversions), which would slow the rate of dispersion of radon and its progeny.

5.2.3 Radiological Soil Monitoring

Soil samples were collected in CY93. However, due to the contract laboratory's failure to meet the conditions of the contract (see section 5.2), no radiological soil sampling data will be presented in this report. Two years of baseline soil analysis data were previously documented in DOE/WIPP 92-037. A substantial baseline of soil analysis data that meets the requirements of DOE Order 5400.1 is available in the Statistical Summary of the Radiological Baseline Program for the WIPP, (DOE/WIPP 92-037).

5.2.4 Hydrologic Radioactivity

The hydrologic radioactivity subprogram is designed to establish characteristic radioactivity levels in surface water bodies, bottom sediments, and groundwater. The following discussion of the hydrologic program includes sampling locations, data collected, and time these data were collected during 1993. It also details refinements made to the program since the publication of the *Radiological Baseline Program Sampling Plan* (Reith and Daer, 1985).

Radiological Surface Water and Sediment Monitoring

There were no radiological surface water or sediment samples collected in 1993. A substantial baseline of surface water and sediment analyses, one that meets the requirements of DOE Order 5400.1, is available in the Statistical Summary of the Radiological Baseline Program for the WIPP (DOE/WIPP 92-037).

Radiological Groundwater Characterization

Groundwater samples were collected in accordance with the Water Quality Sampling Program (WQSP). The primary objective of the WQSP is to obtain using rigorous field and laboratory procedures and protocols, representative groundwater data from selected wells. At each well site, the well is purged and the groundwater serially analyzed for specific field parameters. Once the field

parameters have stabilized denoting a chemical steady state with respect to those parameters analyzed, a final groundwater sample is collected and analyzed for radionuclides. The controlling document for the WQSP is the *WIPP Water Quality Sampling Plan and Procedures Manual* (WP 02-1, Rev 2).

The primary water bearing units being evaluated by the WQSP are the Culebra and Magenta Dolomite members of the Rustler Formation. In 1993 groundwater data were gathered at 10 well locations. Data were collected at eight locations completed in the Culebra dolomite. Water quality data were also collected from two privately owned wells in the area near the WIPP site. These two private wells provide water for area livestock. An in-depth discussion of groundwater hydrology and a figure showing well locations is presented in Chapter 7.0, Groundwater Surveillance.

5.2.5 Biotic Radioactivity

Biotic samples were collected in CY93. However, due to the aforementioned problems concerning the laboratory contract, no radiological biotic sampling data will be presented in this report. Two years of baseline biotic analysis data were previously documented in DOE/WIPP 92-037.

5.3 Assessment of Potential Dose to the Public

In 1993 no waste was received at the WIPP. Therefore, the public could not be exposed to radiation due to WIPP operations. Documentation of naturally occurring background radiation is discussed in Chapters 5 and 7 of this report.

Table 5-1
Activity Concentrations in Quarterly Averages of Low Volume Aerosol Filters
(Bq/ml)

FIRST QUARTER 1993

LOCATION	ALPHA	BETA
Carlsbad	5.22 E-10	7.23 E-10
Smith Ranch	4.75 E-10	9.64 E-10
Mills Ranch	4.97 E-10	9.35 E-10
WIPP Far Field	4.86 E-10	9.24 E-10
WIPP South	5.07 E-10	9.61 E-10
WIPP East (1)	5.26 E-10	9.47 E-10
Eunice	5.32 E-10	9.74 E-10
South East Control	5.04 E-10	9.74 E-10

SECOND QUARTER 1993

LOCATION	ALPHA	BETA
Carlsbad	2.62 E-10	7.02 E-10
Smith Ranch	2.26 E-10	7.11 E-10
Mills Ranch	2.64 E-10	6.13 E-10
WIPP Far Field	2.57 E-10	6.01 E-10
WIPP South	2.54 E-10	6.22 E-10
WIPP East (1)	2.56 E-10	6.01 E-10
Eunice	2.78 E-10	6.46 E-10
South East Control	2.51 E-10	5.74 E-10

THIRD QUARTER 1993

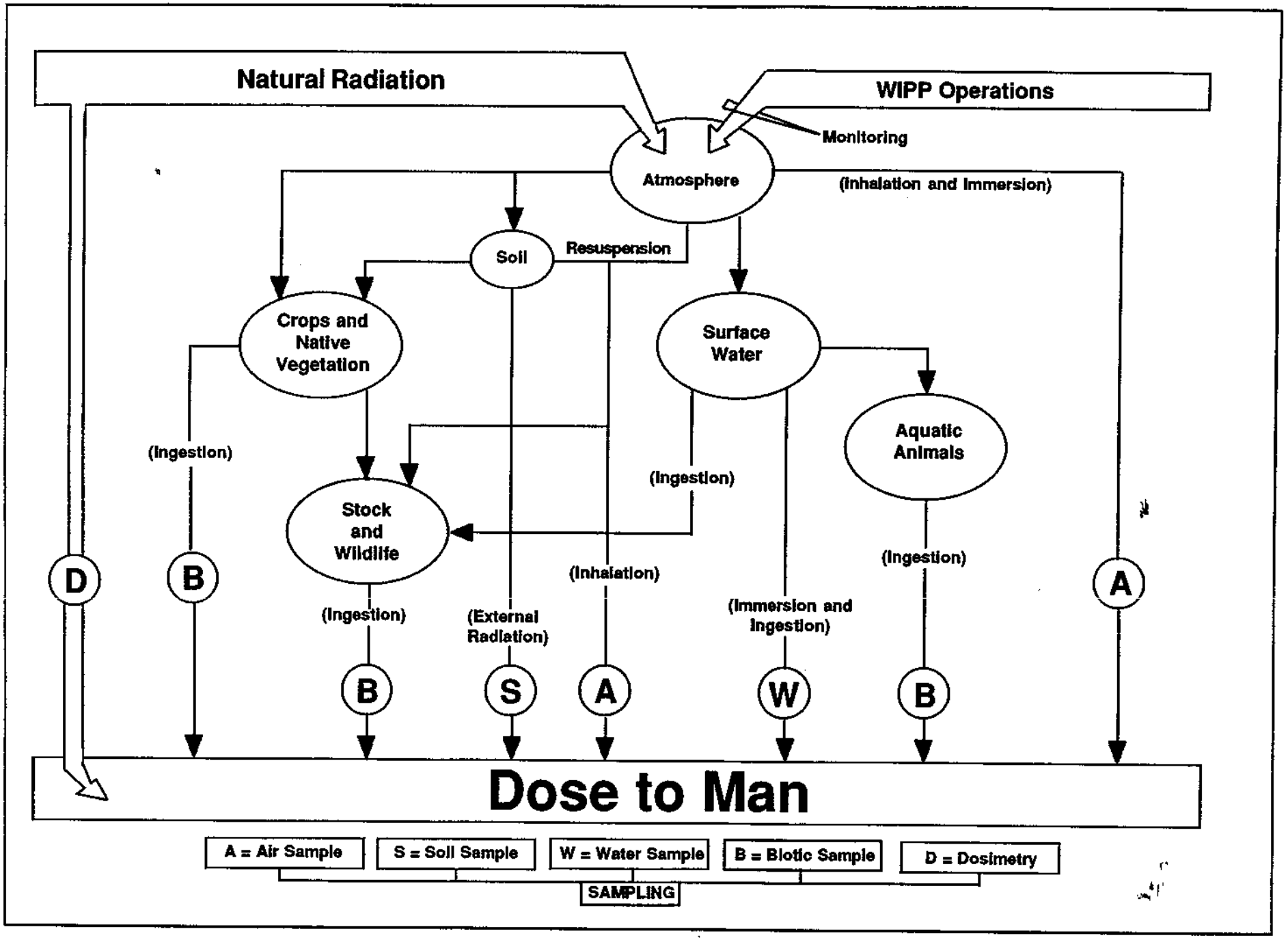
LOCATION	ALPHA	BETA
Carlsbad	2.89 E-10	8.84 E-10
Smith Ranch	2.45 E-10	8.54 E-10
Mills Ranch	2.82 E-10	8.12 E-10
WIPP Far Field	2.87 E-10	8.51 E-10
WIPP South	2.82 E-10	6.81 E-10
WIPP East (1)	3.20 E-10	8.30 E-10
Eunice	3.04 E-10	9.39 E-10
South East Control	2.50 E-10	7.94 E-10

FOURTH QUARTER 1993

LOCATION	ALPHA	BETA
Carlsbad	2.52 E-10	1.60 E-09
Smith Ranch	2.33 E-10	1.39 E-09
Mills Ranch	2.77 E-10	1.29 E-09
WIPP Far Field	1.26 E-10	1.51 E-09
WIPP South	2.11 E-10	1.47 E-09
WIPP East (1)	2.89 E-10	1.32 E-09
Eunice	2.93 E-10	1.27 E-09
South East Control	2.23 E-10	1.23 E-09

Figure 5-1

PRIMARY PATHWAYS TO MAN FOR RADIOACTIVE RELEASES FROM THE WIPP SITE



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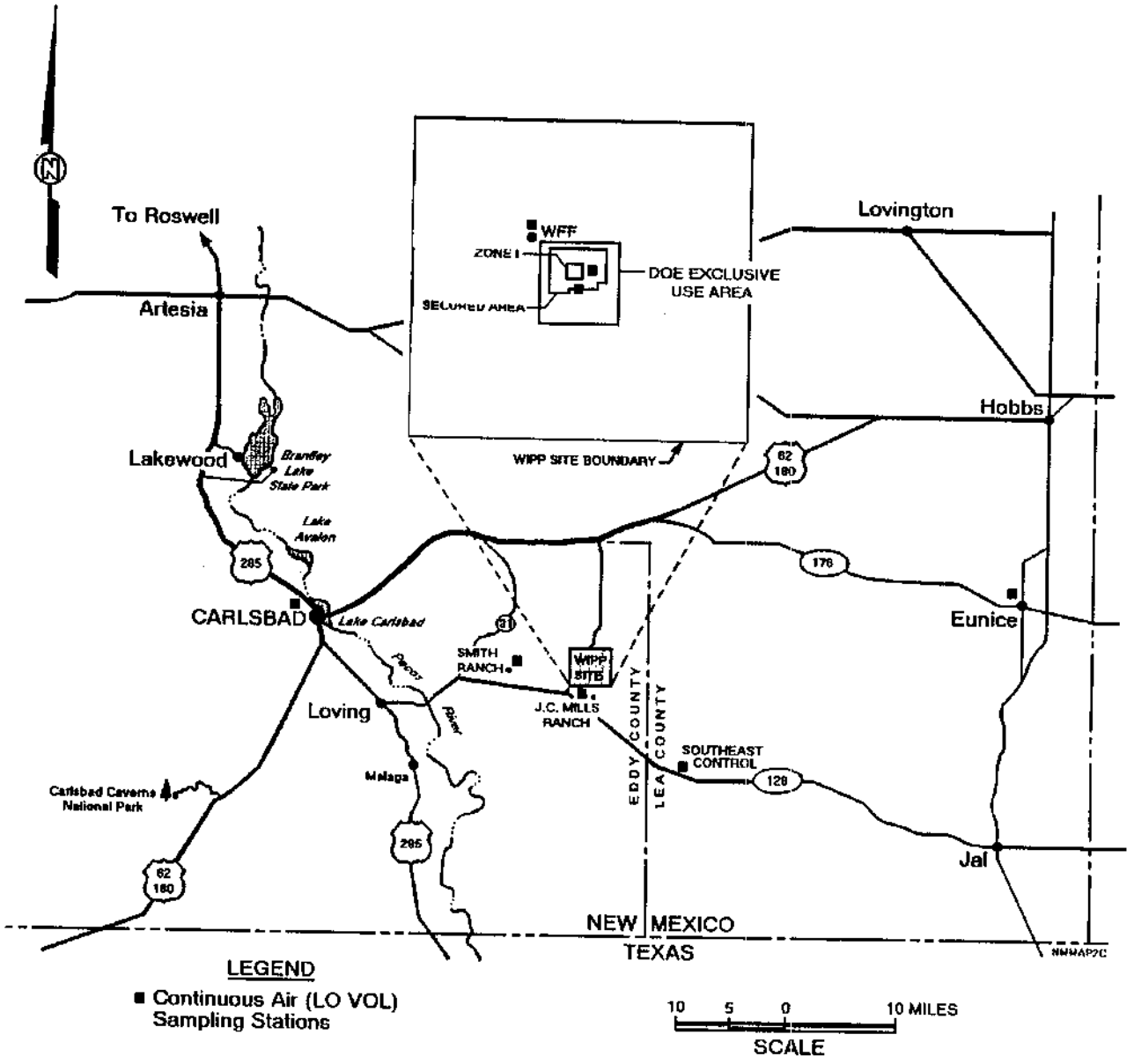

Figure 5-2
Continuous Air Sampling Stations

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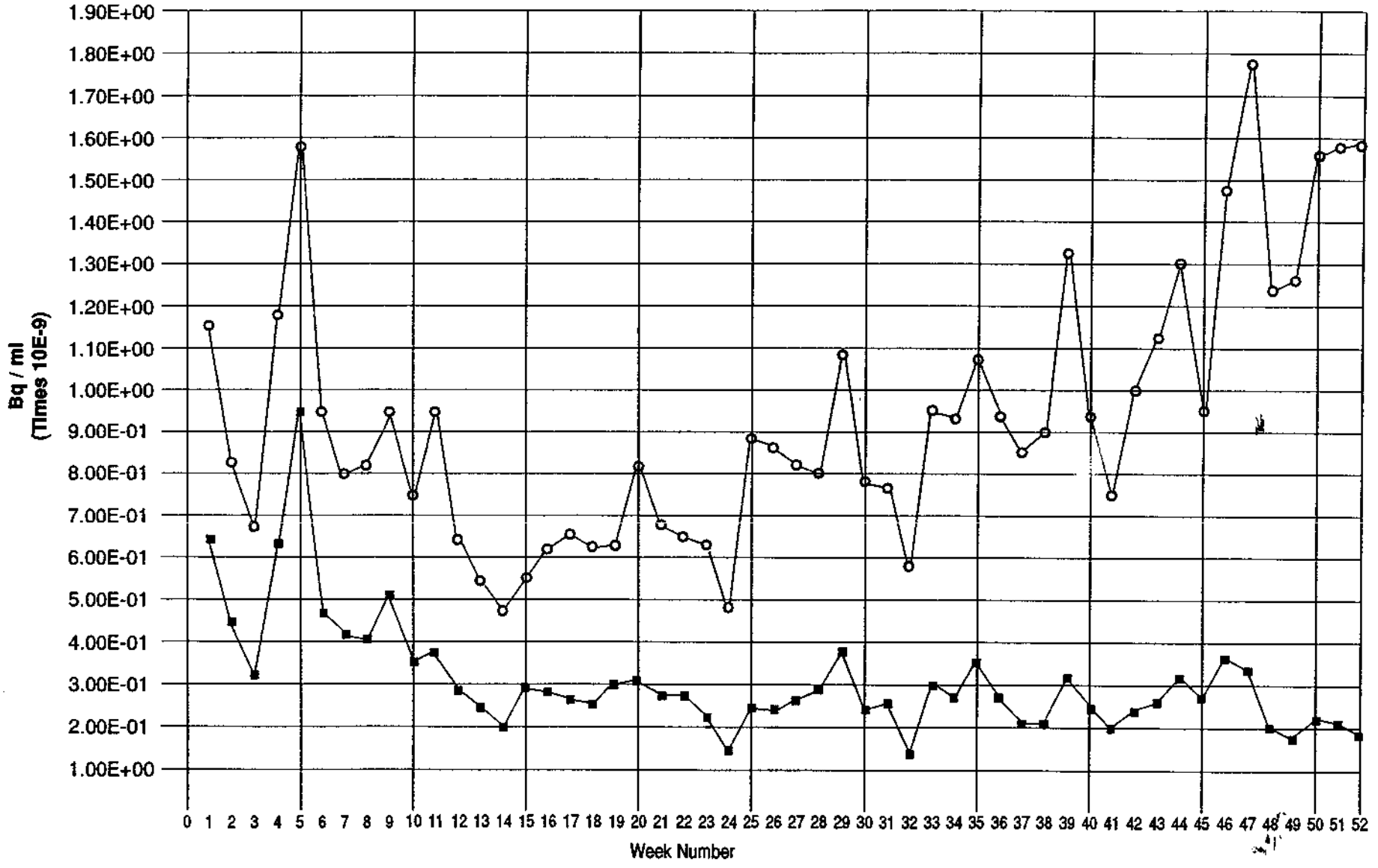
Figure 5-3

1993 Gross Alpha / Gross Beta Concentration

Average of all locations



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CHAPTER 6

ENVIRONMENTAL NONRADIOLOGICAL PROGRAM INFORMATION

Chapter 6
Environmental Nonradiological Program Information

The EMP (DOE/WIPP 94-024) for the WIPP defines the scope and extent of the WIPP effluent and environmental monitoring programs and quality assurance and the quality control programs during the operational life of the facility. The monitoring program is divided into two segments - radiological and nonradiological monitoring. Nonradiological Environmental Surveillance, discussed in this chapter, is conducted by the Environmental Monitoring Section of the Environmental, Safety and Health Department.

The principal functions of the NES are to:

Detect and quantify the impacts of construction and operational activities at the WIPP on the surrounding ecosystem

Continue the development of the ecological database for the Los Medanos Area that was initiated by the WIPP Biology Program

Investigate unusual or unexpected elements in the ecological databases

Provide environmental data that are important to the mission of the WIPP project, but which have not or will not be acquired by other programs

This Chapter of the ASER presents and discusses data collected between January 1, 1993, and December 31, 1993, as part of the NES. Ecological monitoring at the WIPP include the following six subprograms: meteorological monitoring, air quality monitoring, wildlife population monitoring, surface disturbance and soil monitoring, vegetation monitoring, and water quality monitoring. In addition to the NES programs, Volatile Organic Compound are monitored as part of the air requirement for the NMD. The results of the environmental monitoring activities and discussions of significant findings are presented in this report.

requirement for the NMD. The results of the environmental monitoring activities and discussions of significant findings are presented in this report.

6-1

requirement for the NMD. The results of the environmental monitoring activities and discussions of

6.1 Meteorology

An important component of the NES is a meteorological station located 600 meters northeast of the site. The primary function of the MET is to generate data to use for modeling atmospheric conditions. The data generated from the meteorological station are wind speed, wind direction, and temperatures at 3, 10, and 40 meters (10, 30, and 130 feet), with dew point and precipitation monitored at ground level. These parameters are measured continuously and the data are logged at fifteen-minute intervals.

In addition to the primary meteorological station, the Atmospheric Monitoring Station (AMS) is located 1000 meters northwest of the site. At the AMS a secondary meteorological station measures and records temperature and barometric pressure at ground level and wind speed and wind direction at 10 meters (30 feet).

6.1.1 Climatic Data

The mean annual temperature for the WIPP area in 1993 was 18°C (64°F). The mean monthly temperatures for the WIPP area ranged from 7°C (45°F) during January to 29.6°C (86°F) in June. Generally, maximum temperatures occur in June through September, while minimum temperatures occur in December through February.

The last freezing day of the 1993-94 winter season was April 28, with a temperature of 0°C (32°F). The first freezing day of the 1993-94 winter season occurred October 27, with -1°C (30°F). The maximum temperature recorded was 43°C (109°F) on July 7.

The annual precipitation at the WIPP site for 1993 was 24 cm (9.4 in), which is 18 cm (7 in) below 1992 precipitation. In other words, the annual precipitation for 1993 was 43 percent less than that recorded for 1992. The average precipitation for the period 1989 through 1993 was 3 percent less than the previous 5-year period (36.8 cm [14.4 in]). Figure 6-1 displays the monthly precipitation at the WIPP.

6.1.2 Wind Direction and Wind Speed

The predominate wind direction in the WIPP area was from the southeast sector (135°). However, winds occurring in late spring were primarily from the west. Various storm systems move through this area that briefly alter the predominate southeasterly winds. Wind speed noted as calm (less than 0.5 meters per second [mps]) occurred seven percent of the time. Winds of 1.4 through 2.7 mps were

the most prevalent over 1993, accounting for 37.2% of the time. Figure 6-2 displays the annual wind data at the WIPP for CY 1993.

6.2 Environmental Photography

Surface photography has been conducted at seven ecological study plots since 1984. Photographs are used to document year-to-year surface impacts at the study plots and are archived for future reference. Although some paths are noticeable in some plots due to foot traffic, very little surface disturbance was noted in the 1993 photographs.

6.3 Air Quality Monitoring

Five classes of pollutant gases are monitored 1000 meters (0.6 mile) northwest of the exhaust shaft at the WIPP site on a continuous basis. These are sulfur dioxide (SO_2), carbon monoxide (CO), ozone (O_3), hydrogen sulfide (H_2S), and oxides of nitrogen (NO, NO_2, NO_x). The data generated by the analyzers showed these gases to be at the lower limit of detection, that is below the baseline concentrations set by the state of New Mexico. The permissible New Mexico state standard for the gases monitored at the WIPP are listed below:

SO_2	0.02 ppm	annual average
	0.10 ppm	24-hour average
CO	8.70	per eight-hour average
O_3	0.06 ppm	per one hour average
H_2S	0.10 ppm	per one half hour average
NO_2	0.10 ppm	24-hour average

The ambient gas monitors are extremely sensitive instruments that require semiannual recertification by a factory engineer. During CY93 the H_2S, SO_2 and NO_x analyzers were replaced with analyzers incorporating more modern technology. These instruments were installed late in CY93 and a long-term evaluation of the data generated by these instruments is unavailable at this time. However, initial indications show H_2S, SO_2, and NO_x data values at or below the lower level of detection for these analyzers. These data are consistent with data gathered by the previous analyzers.

In addition, weekly measurements of Total Suspended Particulates (micrograms per cubic meter) are made from the particulates collected by the low-volume continuous air sampler at the Far-Field air-sampling location. These filters can load with dust particles due to the arid climate of this area; however, this poses no health concern.

6.4 Wildlife Population Monitoring

Population density measurements of breeding birds and small nocturnal mammals are performed annually to assess the effects of WIPP activities on wildlife populations. Two permanent study plots adjacent to the WIPP facility are used for each of these two classes of wildlife. The data are compared to the data from two control sites for each class. Trap grids are used to measure small mammal populations, and 2,500-foot-long Emlen transects are used to measure bird population densities.

6.4.1 Cooperative Raptor Research and Management Program

In CY93 the Raptor Program focused on the impacts of human-related activities on four distinct groups of Harris' Hawks (*Parabuteo unicinctus*). During the course of the year, nest locations of the hawks were identified and nestlings were banded (in accordance with federal banding permit #22476 and state banding permit #1961) with U.S. Fish and Wildlife bands and anodized aluminum color bands inscribed with alpha numeric codes. These groups will serve as indicators for the data-sharing network between the WIPP and the BLM. Moreover, nest locations of supplementary groups of Harris' Hawks, in addition to nest sites of divergent species (e.g., Swainson's Hawks, Chihuahuan Raven) were located. Nest locations were identified with Loran Navigators and provided to the BLM for incorporation into its land use determinations (e.g., oil and gas activities).

In previous years, several oil wells that had been scheduled to be drilled in close proximity to active nest sites were relocated. Had the information from the wildlife monitoring program been unavailable to the BLM, the nests would have been disturbed.

In 1994, the WIPP proposes to continue these activities in addition to examining the subtle territorial behaviors in the color-marked groups of Harris' Hawks.

Guidance and assistance is welcomed from the local BLM office, the New Mexico Department of Game & Fish, and the U.S. Fish & Wildlife Service. In addition, WIPP will solicit program recommendations from University of Arizona raptor specialists.

6.4.2 Breeding Bird Densities

The densities and distributions of breeding birds between the WIPP transects and the control transects conformed to patterns reported in previous years (Table 6-1). A greater number of species and a higher total density of birds were found in the Southeast 1 (SE-1) and the Northwest 2 (NW-2) transects, with an overall percentage increase of 0.23% and 32.3% respectively. The Control 1 (CT-1) plot showed similar increases of 29.6%. The CT-1, SE-1 and NW-2 plots showed a substantial increase in densities of birds - 14 new species were observed. This increase is possibly due to major oil field activity north, south, east, and west of the 16-section land withdrawal area. Noise levels are markedly higher in areas with oil production activity and loss of habitat in these areas is apparent, possibly forcing the birds away from these areas toward the 16-section land withdrawal area. New oil field activity southwest of the site has, as predicted, resulted in an 11.1% decline of bird activity in the CT-2 transect. A new well was drilled just yards north of the existing CT-2 Emlen line.

Insect dependant species continue to be more abundant near the site than in previous years. For example, there is a greater number of flycatchers. Populations of nesting barn swallows are also on the rise. A new seed eater species, pigeon, has been seen flying over the site but, to date, no nests have been found. A nest count was conducted on-site in June. The most common nester is the barn swallow. Forty-two active broods were located. Other on-site nesters include Western king birds (21 nests); house finches (2 nests); and house sparrow, Say's phoebe, killdeer, northern (Bullock's) oriole, and cactus wren (1 nest each).

The monitoring of the 21.5-mile-line transect, begun in September of 1991, was conducted monthly to assess which species utilize this region year-round or as a fly-way during migration (Table 6-2). As most birds are migratory, the possibility of seeing rare, threatened, or endangered species during the Emlen transects is minute. Examples of these species include the Peregrine and Aplomado Falcons. Although never seen during the Emlen transects, these state and federally endangered falcons have been documented within range of the 21.5-mile transect and, indeed, are species WIPP activities could possibly affect.

The 1993 observations on the 21.5-mile transect listed no threatened or endangered species; however, sightings which would be considered significant for this area are sandhill crane, Bewick's wren, pine siskin, cliff swallow, rock wren, mountain bluebird and blue-gray gnatcatcher.

From 1984 through 1993, WIPP avian surveys have identified 98 species that inhabit or migrate through the areas. Extensive avian studies in southeastern New Mexico suggest that there could be up to 300 species on-site.

6.4.3 Small Nocturnal Mammal Population Densities

Starting with the outbreak of Hanta virus in the spring of 1993, small nocturnal mammal censuses were conducted on two study plots rather than on the usual four. Midway through the census period there had been outbreaks of the virus in New Mexico and every state bordering New Mexico. The chief vector for the disease had been determined to be the deer mouse, *Peromyscus maniculatus*, a mammal encountered on all four transects. To protect researchers from possible exposure, the remaining 1993 censuses for NW-2 and CT-2 and all future censuses were cancelled until precautionary controls could be implemented. Recommendations from the New Mexico Environment Department, the Centers for Disease Control, and Los Alamos National Laboratories will be addressed and satisfied prior to reestablishment of this program in 1994. In addition to establishing safety procedures, blood serum samples will be extracted and analyzed for the presence of Hanta virus in specimens collected from southeastern New Mexico.

Tables 6-3 and 6-4 summarize the results of the 1993 small mammal surveys in the Control 1 (Ct1) and WIPP Southeast 2 (SE2) trap grids. Grids are composed of 100 traps set in a 150m x 150m grid with traps spaced 15 meters apart. Trapping sessions began June 15, 1993, and ended June 24, 1993. Mammals were trapped using Sherman live traps baited with milo.

Mammals were trapped and released for two weeks, three successive nights per week. Larger mammals, such as kangaroo rats, pains wood and hispid cotton rats, deer mice, and grasshopper mice were tagged with numbered ear tags. Silky pocket mice were marked with a stain on their side or head. Grid location of trapped individuals as well as genus, species, new or recapture, tag number or location of stain, sex, and weight were logged on Small Mammal Data sheets. From this data, population densities, actual numbers of captures for each genus, and travel distances for recaptured individuals were calculated.

Population densities were calculated using the Schnabel Method (Tanner, 1978) for mark and recapture mammal trappings. Kangaroo rats were the most common species encountered. Tables 6-3 and 6-4 list the actual number of captures rather than statistical populations for each plot.

Within each grid, each rodent occupies a certain territory or range. By plotting data on recaptured animals, grid locations, and the total distance each animal traveled within the grids during the two

trapping sessions was determined. Of the 27 kangaroo rats surveyed, 5 were recaptured each night in the same trap location, whereas 13 out of 24 plains woodrats were captured in the same location. These figures show the woodrat is more likely to stay in its home range. Several Ord's kangaroo rats were recaptured 30 to 85 meters from their original capture locations, while those recaptured ventured 49 meters from their original capture locations. According to these calculations, the Ords were more active in 1993 than in 1992 by an average of 30 meters. 1993 marked a decline for woodrat captures. Twenty-four individuals were captured and tagged. The average distance traveled by woodrats was 9 meters.

Females of both species were dominant in CT1; whereas males dominated in both species in SE2. Densities dropped significantly for the kangaroo rats in both grids sampled. A total of 24 wood rats were trapped in both plots for CY93. This is a moderate decline in total captures of woodrats in 1993 and a moderate decrease in the 1985 to 1992 average. The overall decline in nocturnal rodent population may be attributed to the droughty conditions that prevailed in 1993. Rodents were more abundant in the control grids than in the WIPP grids; however, no grasshopper mice or silky pocket mice were captured.

6.5 Surface and Subsurface Soil Monitoring

Surface and subsurface soil monitoring was temporarily discontinued in CY92. Substantial analysis of soil was performed from 1984 to 1990. A detailed discussion of the non-radiological soil monitoring program is available in the report titled *Summary of the Salt Impact Studies at the WIPP, 1984 to 1990* (DOE/WIPP 92-038). This program could be reinstated if, in the future, elevated salt levels were suspected in the topsoil adjacent to the salt storage piles.

6.6 Vegetation Monitoring

Vegetation in each of the seven ecological monitoring plots was measured in the fall to assess the effect of the salt tailings on the proximal plant community structures. In each plot, foliage of each species and species diversity were measured using the methods described in Reith, et al, 1985. The frequency of a species is defined as the proportion (percent) of the quadrats containing that species. The 1993 fall vegetation summaries are presented in Table 6-5. Species listed in the table with zero data values were not encountered during the 1993 survey; however, these species are known to exist in the WIPP ecological monitoring plots.

The total CY93 precipitation rate of 23.88 cm. (9.4 in.) was a dramatic decrease over the 1992 total precipitation rate of 42.11 cm (16.58 in). Drought conditions persisted from February through May

and improved as precipitation began to increase in April. However, relatively little precipitation fell throughout the summer, resulting in stressed plants and drought conditions by the end of September.

The CY93 vegetation monitoring data showed an increase, for the first time since 1989, of perennial grasses with their increasing proximity to the salt tailings. The total coverage of these grasses in all plots was relatively uniform over all distances from the tailings. Although densities of annuals and species richness were slightly greater in the nearfield plots, overall, species remained relatively uniform across all plots. A pattern observed from the 1989 through 1992 data, which was also seen in the 1993 data, is an increase in shrub cover with increasing proximity to the salt tailings. A departure from the 1989 through 1992 data was an approximately equal richness, overall, in the perennial grass cover as opposed to the decline observed in the past. This common effect of secondary salination may be declining as the salt tailings become more solidified through time. The responses of these plots to higher rainfall in later years will reveal whether adverse effects of salination will prevail or begin to abate in the structure of the plant community or whether these responses are only a short-term effect caused by short-term weather conditions. Weather conditions had a uniform effect on vegetation in all plots. Prodigious differential effects resulting from salt-induced physiological stress near the salt tailings was not observed.

The mine tailings may not be having great negative effects on the surrounding plant communities in the form of eolian salt deposition. The nature of the salt is to become compacted and solidified by the heavy machinery and moisture. Run-off is collected in the catchment basin where it is evaporated to the atmosphere and absorbed into the soil. Any resulting salt crust is then weathered and partially dispersed to the surrounding area. This represents only a minimal deposit. Interestingly, wildlife has been observed using the salt tailings as a source of salt, similar to cattle using salt licks.

6.7 National Pollutant Discharge Elimination System Data

The WIPP completed the WIPP NPDES Storm Water Pollution Prevention Plan (PPP) in March 1993. The NPDES Storm Water Permit rules require that a PPP be developed for each facility covered under the permit by April 1, 1993. The PPP identifies and assesses potential pollutant sources and describes all Best Management Practices that will be implemented to ensure that storm water runoff does not contact regulated pollutants. Additionally, the WIPP outlined a schedule for the implementation of all BMPs required to demonstrate compliance with all permit requirements.

The completion of Best Management Practices identified in the WIPP NPDES Storm Water Pollution Prevention Plan include: 1) the construction of storm water retention basins to collect all Zone 1 storm water discharges; 2) the covering of all material storage areas to prevent contact with

precipitation runoff; 3) the covering of the Sandia Diesel generators; 4) construction of berms around all material storage areas outside of Zone 1; and 5) the storage of all recycled batteries in the Excess Storage Area on spill containment devices. Additionally, disturbed areas that are no longer in use are being reclaimed. Reclamation of the unused portions of the Construction Landfill has been completed.

The NPDES Storm Water Pollution Prevention Plan establishes a preliminary schedule for the initiation of reclamation activities for all but 16 of the Solid Waste Management Units (SWMUs) located within the WIPP Land Withdrawal Area. The schedule for the completion of reclamation activities for these 16 SWMUs is contingent upon negotiation with EPA Region VI. The DOE does not anticipate that the assessment, remediation, and reclamation of these 16 SWMUs will be initiated until a Disposal Phase RCRA/HSWA permit is issued for the WIPP.

6.8 Volatile Organic Compounds Monitoring

As stated in Section 3.2.3, the WIPP has developed and implemented a Volatile Organic Compound (VOC) monitoring program to satisfy the air monitoring requirements of the NMD for the WIPP (55 FR 47700). The data resulting from this program are reported in the NMD annual reports submitted to the EPA. As stated in Section 3.2.3, the most recent report titled, *Waste Isolation Pilot Plant No-Migration Determination Annual Report for the period of October 1991 through August 1992* (DOE/WIPP 92-057), was submitted to the EPA on November 11, 1992.

Unlike the other programs listed in this chapter, the WIPP VOC Monitoring Program is not included in the EMP for the WIPP (DOE/WIPP 88-025) and is not implemented by the Environmental Monitoring Section. Rather, the WIPP VOC Monitoring Program is implemented by the Dosimetry and Analytical Technology Section of the Environment, Safety and Health Department, and the implementing documents are specific to the program. These include *VOC Monitoring Plan for Bin-Room Tests* (WP 12-6) and *Volatile Organic Compounds Monitoring Quality Assurance Program Plan* (WP 12-7).

6.9 Reclamation of Disturbed Lands

During CY93, the WIPP adopted contemporary reclamation techniques more conducive to a desert environment. Rather than using prescribed techniques involving deep ripping and tillage, WIPP used a shallow tillage reclamation drill. The use of this type of drill allows for the retention of critical sub-moisture while distributing seed rates at determined intervals and desired depths.

Reclamation activities during CY93 consisted of fence construction around an existing reclamation site. The fence was constructed according to BLM specifications. Surface areas comprising a retention basin for water were hand seeded and minor erosion control measures were taken. Additionally, a construction landfill area was capped and reseeded in order to comply with NPDES stormwater discharge permit requirements.

Due to the lack of precipitation during 1993, seed germination on reclamation sites was negligible. Success or failure of shallow-tillage reclamation techniques is contingent on precipitation.

6.10 Seismic Activity

There were a total of 76 earthquakes located within 300 kilometers of WIPP in 1993. Major readings on the Richter Scale were: 3.2 (Ruidoso, December 22, 1994), 3.1 (Presidio, July 15, 1994), 2.8 (Odessa, June 23, 1994), and 2.5 (Hobbs, August 26, 1994). From June through December there was increased activity along the Central Basin Platform south of Odessa with 19 seismic events with readings ranging from 1.2 to 2.8. There were two events, 1.1 and 1.2, which were located near the Rattlesnake Canyon earthquake epicenter of January 2, 1992.

Historically, the seismic information for the WIPP facility region before 1962 is based on chronicles of the effects of those tremors on people, structures, and land forms (called macroseismic evidence). Since 1962 virtually all seismic information is based on instrumental data recorded at various seismograph stations. Currently, seismicity is being monitored at the New Mexico Institute of Mining and Technology (NMIMT), Socorro, using data from a seven-station network centered on the WIPP (Figure 6-3). The stations are telemetered to the NMIMT Seismological Observatory. Seismicity is also being monitored from other New Mexico stations and from bordering states.

Pre-1962 seismicity reported in New Mexico occurred in the Rio Grande Valley area between Albuquerque and Socorro and is associated with a structure known as the Rio Grande Rift. These earthquakes had intensities of Modified Mercalli V or greater as based upon the perceptions of people experiencing these quakes. More recently, from January 1, 1962 through November 28, 1974, seismicity near the site has been registered with readings as great as 3.8 in magnitude.

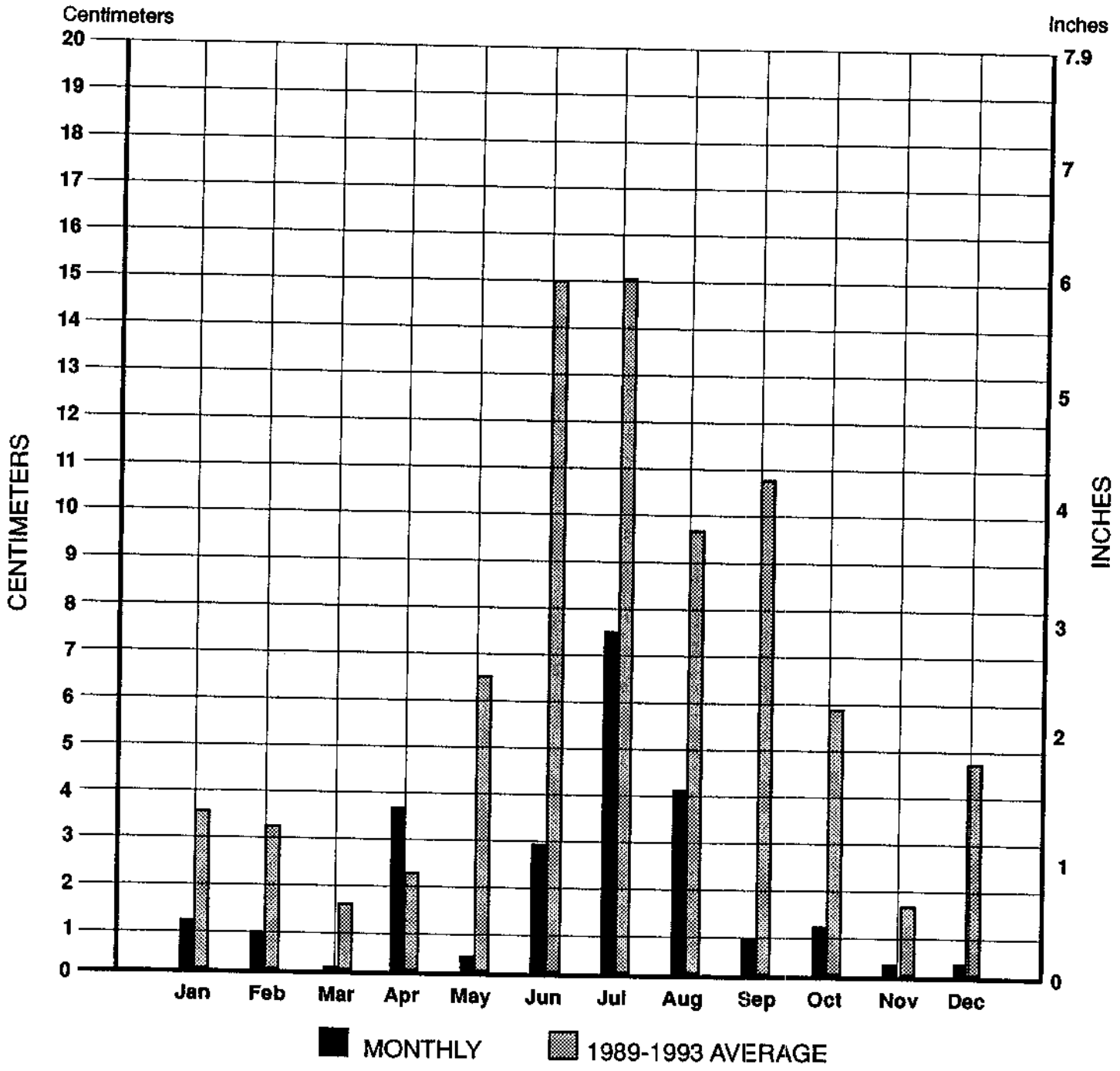
Geologic structures and tectonism of the Permian Basin are associated with large-scale basin, inter-basin, and basin-margin subsidence or emergence that occurred during the Paleozoic era. The WIPP facility is about 60 miles from the western margin of the Permian Basin. The basin is a broad structural feature made up of a series of Paleozoic sedimentary basins whose last episodes of major subsidence occurred during late Permian time. The area today is characterized by the basin filled with

thick evaporite layers and bordered by the Amarillo uplift to the north, the Marathon thrust belt to the south, and the Diablo Platform, Sacramento and Guadalupe Mountain orogenies to the west. All major tectonic elements of the Permian Basin were completely formed before deposition of the Permian salt-bearing rocks, and the region has been relatively stable since that time. Deep-seated faults are rare except along the west margin of the basin and no indications of younger deep-seated faults are noted.

Central Basin Platform related seismicity may not be entirely tectonic, but instead, may be related to water injection and withdrawal for secondary recovery operations in oil fields. Similar evidence suggests that the June 16, 1978 event near Snyder, Texas, may have been induced by secondary oil recovery operations. The depth of the earthquake closely approximates the bottom of drillholes located in this gas producing area.

There is little indication that significant magnitude events are likely to occur in the WIPP facility zone. There is no Quaternary fault offset, and seismic activity is low. Analysis of risk for the WIPP facility source zone suggests that in the event of 4.5 magnitude would have been the maximum historical event near the site of tectonic origin plus about one magnitude unit and an event of 5.5 as the maximum event recorded anywhere within the Permian Basin subregion, plus about one magnitude unit.

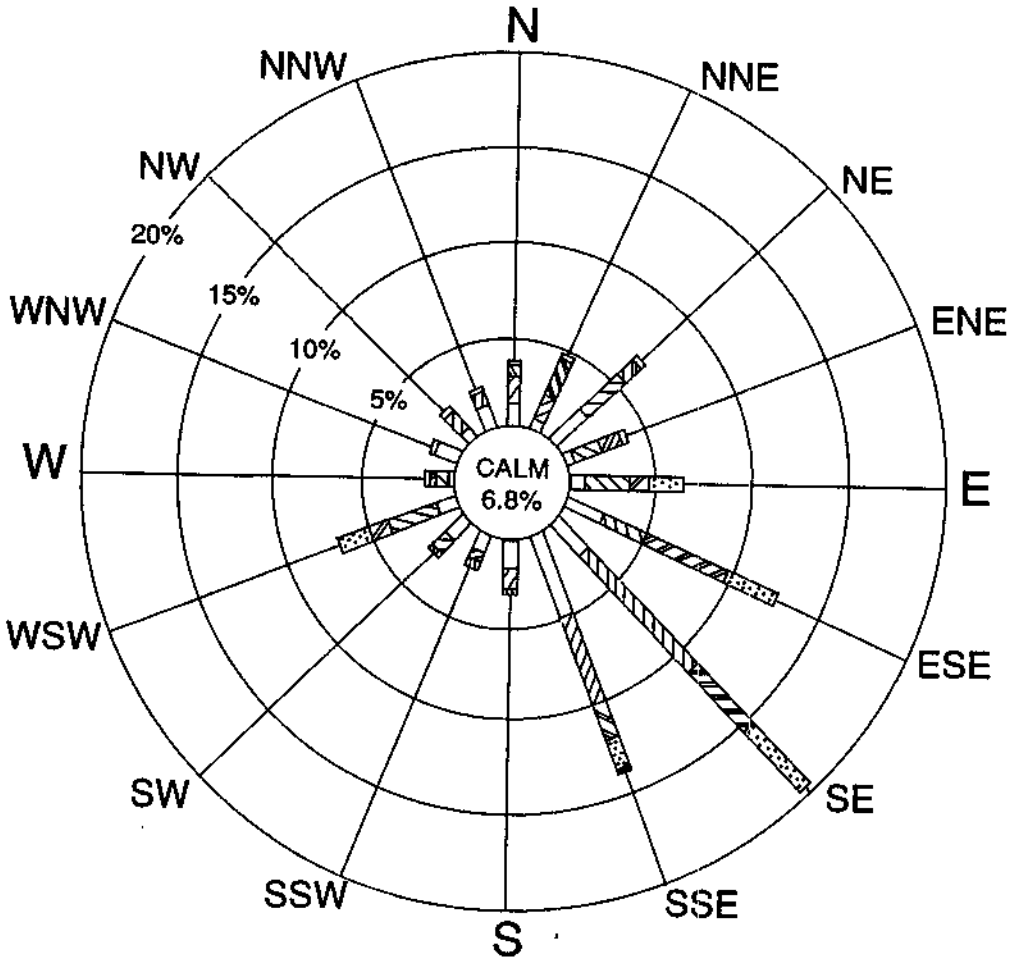
Figure 6-1
1993 Precipitation



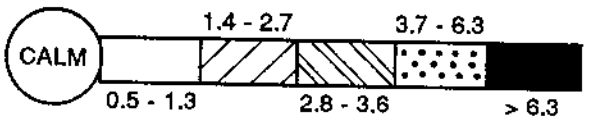
694B:6501I

Figure 6-2

ANNUAL WINDROSE 1993



LEGEND



WIND VELOCITY IN METERS PER SECOND

Table 6 - 1

Summary of the 1993 EMLEN Breeding Bird Density Measurements in Birds per 40 ha.

PLOTS:	CT1	CT2	1993 AVERAGES	84-93 AVERAGES	NW2	SE1	1993 AVERAGES	84-93 AVERAGES
BIRD SPECIES								
CATTLE EGRET	0.0	0.0	0.0	0.0	6.5	0.0	3.2	0.2
SANDHILL CRANE	8.6	0.0	4.3	0.2	0.0	0.0	0.0	0.0
KILLDEER	0.0	4.3	2.1	0.1	0.0	7.3	3.7	5.3
WILSON'S PHALAROPE	0.0	0.0	0.0	0.0	8.6	0.0	4.3	0.2
TURKEY VULTURE	0.0	0.0	0.0	0.0	8.6	0.0	4.3	0.2
NORTHERN HARRIER	0.0	0.0	0.0	0.6	0.0	0.0	0.0	2.1
SWAINSON'S HAWK	2.8	0.0	1.4	0.1	8.6	4.3	6.4	3.3
HARRIS' HAWK	0.0	4.3	2.1	1.1	0.0	0.0	0.0	0.0
OSPREY	2.1	0.0	1.1	0.1	0.0	0.0	0.0	0.0
NORTHERN BOBWHITE	13.4	17.2	15.3	10.9	14.3	11.7	13.0	10.3
SCALED QUAIL	3.2	25.8	14.5	11.4	34.5	0.0	17.2	10.9
ROCK DOVE	0.0	0.0	0.0	0.0	5.3	0.0	2.8	0.1
MOURNING DOVE	12.9	4.3	8.6	10.9	7.3	3.7	5.5	6.3
GREATER ROADRUNNER	0.0	0.0	0.0	0.0	17.2	8.6	12.9	8.2
COMMON BARN-OWL	0.0	0.0	0.0	0.0	0.0	8.6	4.3	0.2
GREAT HORNED OWL	12.2	0.0	6.1	6.0	0.0	0.0	0.0	0.1
BURROWING OWL	0.0	0.0	0.0	0.0	0.0	8.6	4.3	0.2
COMMON POORWILL	0.0	0.0	0.0	0.2	0.0	0.0	0.0	0.1
COMMON NIGHTHAWK	0.0	8.6	4.3	2.8	10.7	17.2	13.9	7.5
LADDER-BACKED WOODPECKER	0.0	0.0	0.0	2.4	9.3	8.6	8.9	7.1
WESTERN KINGBIRD	11.3	11.8	11.5	9.4	18.8	15.6	17.2	15.8
SCISSOR-TAILED FLYCATCHER	0.0	0.0	0.0	0.2	3.2	34.5	18.8	11.7
ASH-THROATED FLYCATCHER	11.2	8.6	9.9	7.3	12.0	12.0	12.0	10.9
SAY'S PHOEBE	8.6	0.0	4.3	2.7	0.0	17.2	8.6	0.5
BARN SWALLOW	17.2	0.0	8.6	0.5	7.9	31.0	19.4	18.0
CHIHUAHUAN RAVEN	15.8	4.8	10.3	7.4	5.1	4.8	4.9	5.8
VERDIN	0.0	0.0	0.0	0.0	17.2	0.0	8.6	0.5
CACTUS WREN	11.1	17.2	14.1	12.6	12.9	16.1	14.5	13.1
LOGGERHEAD SHRIKE	7.7	7.9	7.8	9.1	9.1	5.4	7.2	5.2
NORTHERN MOCKINGBIRD	15.3	14.0	14.6	12.4	14.0	15.0	14.5	12.8
SAGE THRASHER	3.2	0.0	1.6	0.1	0.0	2.1	1.0	0.1
CURVE-BILLED THRASHER	3.6	6.5	5.0	0.3	8.6	17.2	12.9	0.7
CRISSAL THRASHER	17.2	0.0	8.6	5.3	0.0	8.6	4.3	4.7
BELL'S VIREO	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
YELLOW-RUMPED WARBLER	0.0	0.0	0.0	0.0	17.2	34.4	25.8	1.4
YELLOW WARBLER	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
PYRRHULOXIA	12.9	18.8	15.8	17.7	28.5	21.2	24.8	22.6
RUFOUS-SIDED TOWHEE	0.0	0.0	0.0	0.0	0.0	17.2	8.6	2.1
GRASSHOPPER SPARROW	0.0	0.0	0.0	1.1	0.0	0.0	0.0	0.0
LARK SPARROW	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
BLACK-THROATED SPARROW	35.5	53.8	44.6	36.9	44.1	53.8	48.9	40.6
SAGE SPARROW	17.2	0.0	8.6	0.5	17.2	20.1	18.6	1.0
CASSIN'S SPARROW	28.3	0.0	14.1	11.7	55.9	34.4	45.1	30.4
RUFOUS-CROWNED SPARROW	0.0	0.0	0.0	1.1	0.0	0.0	0.0	0.0
CHIPPING SPARROW	17.2	8.6	12.9	0.7	17.2	0.0	8.6	0.5
BREWER'S SPARROW	17.2	17.2	17.2	8.7	14.3	8.6	11.4	7.4
WHITE-CROWNED SPARROW	0.0	0.0	0.0	0.0	17.2	0.0	8.6	12.9
YELLOW-HEADED BLACKBIRD	0.0	0.0	0.0	0.3	0.0	0.0	0.0	0.1
RED-WINGED BLACKBIRD	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.1
BREWER'S BLACKBIRD	0.0	17.2	8.6	4.8	60.2	0.0	30.1	18.7
BROWN-HEADED COWBIRD	10.7	7.2	8.9	8.2	4.31	8.0	6.1	7.5
LARK BUNTING	19.9	0.0	9.9	8.8	0.0	21.5	10.7	11.9
MEADOWLARK	11.8	9.7	10.7	9.7	11.3	9.2	10.2	8.3
NORTHERN ORIOLE	8.6	0.0	4.3	3.2	18.6	0.0	9.3	6.6
HOUSE SPARROW	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
AMERICAN GOLDFINCH	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.1
LESSER GOLDFINCH	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.1
HOUSE FINCH	0.0	0.0	0.0	0.01	0.0	17.2	8.6	6.9
TOTAL DENSITY IN 1993 PER 40ha.	356.7	267.8	311.6	232.9	555.2	487.1	520.2	349.6
AVERAGE AVIAN DENSITY PER 40ha (1992-93)	303.9	284.5	294.3	208.9	465.6	486.5	476.0	308.6
NUMBER OF SPECIES 1993	28	20	32	40	35	31	41	53
TOTAL SPECIES OBSERVED1984-93	58							

Species in Italics are considered threatened or endangered federally and/or by New Mexico.

Table 6 - 2
Observed Avifauna of Los Medanos and Surrounding Ecotones
1993

MONTH OBSERVED	J	F	M	A	M	J	J	A	S	O	N	D	SPECIES TOTALS
BIRD SPECIES													
BLACK-CROWNED NIGHT-HERON	0	0	0	>525	209	26	0	0	0	0	0	0	>525
SNOWY EGRET	0	0	0	0	66	42	8	0	0	0	0	0	66
GREAT BLUE HERON	0	0	0	0	0	0	0	0	0	0	0	0	0
SANDHILL CRANE	3	0	0	0	0	0	0	0	0	0	0	0	3
BLUE-WINGED TEAL	0	0	0	0	0	0	0	0	0	0	0	0	0
AMERICAN COOT	0	0	0	0	0	0	0	0	0	0	0	0	0
SNOWY PLOVER	0	0	0	0	0	1	0	0	0	0	0	0	1
BLACK-NECKED STILT	0	0	0	1	0	0	0	0	0	0	0	0	1
KILLDEER	0	0	0	1	1	0	0	0	1	0	0	0	3
SEMIPALMATED SANDPIPER	0	0	0	0	0	0	0	0	0	0	0	0	0
LEAST SANDPIPER	0	0	0	0	0	0	0	0	0	0	0	0	0
RING-BILLED GULL	0	0	0	0	0	0	0	0	0	0	0	0	0
TURKEY VULTURE	0	0	1	1	16	17	4	16	10	0	0	0	65
GOLDEN EAGLE	0	0	0	0	0	0	0	0	0	0	0	0	0
NORTHERN HARRIER	5	4	8	10	0	0	0	1	4	7	1	9	49
SHARP-SHINNED HAWK	0	0	0	0	0	0	0	0	0	0	0	0	0
RED-TAILED HAWK	11	6	3	9	1	4	2	3	3	3	5	7	46
SWAINSON'S HAWK	0	0	0	14	5	7	8	14	9	1	0	0	58
ROUGH-LEGGED HAWK	0	0	0	0	0	0	0	0	0	0	0	0	0
FERRUGINOUS HAWK	0	0	1	1	0	0	0	0	0	0	1	1	3
HARRIS' HAWK	0	0	0	6	5	3	1	1	1	1	6	6	30
AMERICAN KESTREL	0	0	0	1	0	0	0	1	5	0	0	0	7
MERLIN	0	0	0	0	0	0	0	0	1	1	0	0	2
PRAIRIE FALCON	1	0	0	0	0	0	0	0	0	0	0	0	1
NORTHERN BOBWHITE	0	0	0	0	4	6	12	0	9	1	2	0	34
SCALED QUAIL	0	1	1	9	3	4	3	9	6	10	0	8	54
MOURNING DOVE	0	2	3	4	20	4	10	9	1	2	0	0	55
GREATER ROADRUNNER	0	0	1	1	0	0	2	2	1	1	1	0	9
GREAT HORNED OWL	0	0	1	3	1	0	0	0	0	0	0	0	5
BURROWING OWL	0	0	0	0	1	5	1	0	0	0	0	0	7
COMMON NIGHTHAWK	0	0	0	0	4	1	13	1	1	0	0	0	20
LESSER NIGHTHAWK	0	0	0	0	0	0	0	0	0	0	0	0	0
RED-SHAFTED NORTHERN FLICKER	0	0	0	0	0	0	0	0	0	0	0	0	0
LADDER-BACKED WOODPECKER	2	0	1	2	0	5	0	0	2	1	0	1	14
WESTERN KINGBIRD	0	0	0	6	14	14	17	1	1	0	0	0	53
SCISSOR-TAILED FLYCATCHER	0	0	0	9	3	2	1	8	11	0	0	0	34
ASH-THROATED FLYCATCHER	0	0	0	0	7	12	5	2	0	0	0	0	26
SAY'S PHOEBE	0	0	2	0	0	0	0	0	1	0	0	0	3
HORNED LARK	0	0	0	0	2	0	0	3	4	0	0	0	9
CLIFF SWALLOW	0	0	0	3	0	0	0	0	0	0	0	0	3
BARN SWALLOW	0	0	0	4	0	0	2	0	1	0	0	0	7
CHIHUAHUAN RAVEN	0	0	11	30	46	30	16	6	0	0	0	0	139
VERDIN	0	0	0	2	2	0	2	0	0	0	0	0	6
BEWICK'S WREN	1	0	0	0	0	0	0	0	0	0	0	0	1
ROCK WREN	0	0	0	0	0	0	0	0	4	1	0	0	5
CACTUS WREN	5	6	24	7	23	7	27	23	16	20	1	7	166
OBSERVED MONTHLY SUBTOTALS	28	19	57	>649	433	190	134	100	92	49	17	37	
OBSERVED SPECIES SUBTOTALS	7	5	12	22	20	18	18	16	21	12	7	7	

Table 6 - 2
(Continued)
Observed Avifauna of Los Medanos and Surrounding Ecotones
1993

MONTH OBSERVED	J	F	M	A	M	J	J	A	S	O	N	D	SPECIES TOTALS
BIRD SPECIES													
RUBY-CROWNED KINGLET	0	0	0	0	0	0	0	0	0	0	1	0	1
BLUE-GRAY GNATCATCHER	0	0	0	0	0	0	0	0	0	0	0	1	1
MOUNTAIN BLUEBIRD	0	0	0	0	0	0	0	0	0	6	0	0	6
HERMIT THRUSH	0	0	0	0	0	0	0	0	0	0	0	0	0
LOGGERHEAD SHRIKE	4	2	12	4	6	2	10	26	9	9	3	14	101
NORTHERN MOCKINGBIRD	0	0	0	3	34	46	35	6	2	8	0	0	134
SAGE THRASHER	0	0	0	1	2	1	2	0	3	1	0	0	10
CURVE-BILLED THRASHER	0	0	0	1	0	0	0	0	0	0	0	0	1
CRISSAL THRASHER	1	0	1	0	0	0	2	0	0	0	0	1	5
AMERICAN PIPIT	0	0	0	0	0	0	0	0	0	0	0	0	0
WILSON'S WARBLER	0	0	0	0	0	0	0	0	0	0	0	0	0
YELLOW-RUMPED WARBLER	0	0	0	0	0	0	0	0	0	0	0	0	0
MACGILLIVRAY'S WARBLER	0	0	0	0	0	0	0	0	0	0	0	0	0
PYRRHULOXIA	23	11	15	26	46	77	94	15	12	2	0	1	322
BLUE GROSBEAK	0	0	0	0	3	1	1	0	0	0	0	0	5
LAZULI BUNTING	0	0	0	0	0	0	0	0	0	0	0	0	0
GREEN-TAILED TOWHEE	0	0	0	0	0	0	0	0	0	0	0	0	0
RUFOUS-SIDED TOWHEE	0	0	0	0	0	0	0	0	0	0	0	0	0
CANYON TOWHEE	3	0	0	0	2	0	0	0	1	1	0	0	7
GRASSHOPPER SPARROW	0	0	0	0	0	0	0	0	0	0	0	0	0
VESPER SPARROW	0	0	0	0	0	0	0	0	0	0	0	0	0
SONG SPARROW	0	0	0	0	0	0	0	0	0	0	0	0	0
LARK SPARROW	0	0	0	0	0	0	0	0	0	0	0	0	0
BLACK-THROATED SPARROW	53	23	29	38	69	79	69	14	11	7	1	2	395
SAGE SPARROW	4	0	17	2	0	0	0	0	0	7	0	0	30
CASSIN'S SPARROW	0	0	71	84	62	77	48	1	0	3	0	0	346
CHIPPING SPARROW	0	0	0	0	4	0	0	7	0	0	0	0	11
BREWER'S SPARROW	0	0	0	0	2	2	2	0	1	0	0	3	10
DARK-EYED JUNCO	0	0	0	0	0	0	0	0	0	0	1	0	1
WHITE-CROWNED SPARROW	10	0	1	0	0	0	0	0	0	0	0	0	11
YELLOW-HEADED BLACKBIRD	0	0	0	0	2	0	0	1	0	0	0	0	3
RED-WINGED BLACKBIRD	0	0	0	0	0	0	0	0	0	0	0	0	0
BREWER'S BLACKBIRD	0	0	0	39	0	0	0	0	0	0	0	0	39
BROWN-HEADED COWBIRD	0	0	0	0	3	2	6	3	0	0	0	0	14
LARK BUNTING	125	52	80	212	2	0	0	41	18	3	0	0	533
MEADOWLARK	18	13	57	25	24	53	53	7	8	33	4	0	295
SCOTT'S ORIOLE	0	0	0	0	0	0	0	0	0	0	0	0	0
NORTHERN ORIOLE	0	0	0	0	0	5	1	6	2	0	0	0	14
PINE SISKIN	0	0	14	29	1	0	0	0	0	0	0	0	44
AMERICAN GOLDFINCH	0	0	14	95	0	0	0	0	0	0	0	0	109
LESSER GOLDFINCH	0	0	0	0	0	0	0	0	0	0	0	0	0
HOUSE FINCH	38	0	0	0	0	0	0	0	0	0	0	0	38
OBSERVED MONTHLY SUBTOTALS	279	101	311	559	262	345	323	127	67	80	10	22	TOTAL
OBSERVED SPECIES SUBTOTALS	10	5	11	13	15	11	12	11	10	11	5	6	SPECIES OBSERVED
1993 MONTHLY TOTALS	307	120	368	120	695	535	457	227	159	129	27	59	62
1993 SPECIES TOTALS	17	10	23	35	35	29	30	27	31	23	12	13	
1992-93 MONTHLY AVERAGES	1243.0	571.0	579.5	948.5	693.5	570.0	565.5	328.0	240.5	211.0	138.5	171.0	
1992-93 SPECIES AVERAGES	20.0	17.5	26.0	39.5	37.5	28.5	31.5	26.0	29.5	24.0	17.0	20.0	

Note: Species without data were observed in previous years but not in 1993.

Table 6-3
Summary of 1993 Small Nocturnal Mammal Densities

MEASUREMENTS ARE INDIVIDUALS PER 150M X 150M TRAP GRID

	CONTROL GRIDS				WIPP GRIDS			
	CT1	CT2	AVE 1993	AVE 85-92	NW2	SE2	AVE 1993	AVE 85-92
ORD'S KANGAROO RAT	20	NA	NA	25	NA	11	NA	19
SILKY POCKET MOUSE	0	NA	NA	11	NA	0	NA	4
NORTHERN GRASSHOPPER MOUSE	0	NA	NA	7	NA	0	NA	7
PLAINS WOODRAT	21	NA	NA	12	NA	21	NA	6
WHITE-FOOTED MOUSE AND DEER MOUSE	4	NA	NA	.25	NA	4	NA	2
TOTAL DENSITY	45	NA	NA	55	NA	36	NA	38

Table 6 - 4
Actual Captures of Nocturnal Mammals in 1993

	CT1	CT2	AVE 1993	AVE 91-92	NW2	SE2	AVE 1993	AVE 91-92
ORD'S KANGAROO RAT	18	NA	NA	34	NA	10	NA	27
WHITE FOOTED/DEER MOUSE	4	NA	NA	.25	NA	4	NA	3
PLAINS POCKET MOUSE	0	NA	NA	6	NA	0	NA	3
GRASSHOPPER MOUSE	0	NA	NA	5	NA	0	NA	3
PLAINS WOOD RAT	12	NA	NA	9	NA	15	NA	6
HISPID COTTON RAT	0	NA	NA	2	NA	0	NA	4

NOTE: 1993 AVERAGES ARE NOT INCLUDED AS THE DATA SET IS INCOMPLETE.

Table 6-5
WIPP 1993 Fall Vegetation Report

TREE, SHRUB, CACTI, YUCCA	ACRO	* CONTROL 1 COVER	FREQ	DENS	* CONTROL 2 COVER	FREQ	DENS
WESTERN SOAPBERRY	SASA	0.00	0.00	0.00	0.06	0.26	0.00
HONEY MESQUITE	PRGL	0.64	1.72	0.00	2.06	6.86	0.00
SHINNERY OAK	QUHA	6.59	21.03	0.00	8.00	34.41	0.00
THREAD-LEAF SAGE WORT	ARFI	1.66	5.30	0.00	0.00	0.00	0.00
SOUTHWEST RABBITBRUSH	CHPU	0.00	0.00	0.00	0.00	0.00	0.00
PLAINS YUCCA	YUCA	1.61	5.14	0.00	0.45	1.93	0.00
PERENNIAL FORBS							
DUNE FLATSEDGE	CYON	0.49	1.56	0.00	0.00	0.00	0.00
PRAIRIE SPIDER-WORT	TROC	0.10	0.32	0.00	0.00	0.00	0.00
LEATHER-WEED CROTON	CRPO	2.22	7.09	0.00	0.00	0.00	0.00
SMOOTH OXYBAPHUS	OXGL	0.26	0.83	0.00	0.16	0.69	0.00
WOOLLY DALEA	DALA	0.12	0.38	0.00	0.56	2.41	0.00
CUTLEAF GOLDENWEED	MAPI	0.14	0.45	0.00	0.00	0.00	0.00
PLAINS BLACKFOOT	MELE	0.90	2.87	0.00	0.00	0.00	0.00
PERENNIAL GRASSES							
SANDBUR	CEIN	2.39	7.63	0.00	1.04	4.47	0.00
FALL WITCHGRASS	LECO	2.26	7.21	0.00	3.15	13.55	0.00
MESA DROPSEED	SPFL	0.00	0.00	0.00	0.49	2.11	0.00
GIANT DROPSEED	SPGI	0.22	0.70	0.00	1.41	6.06	0.00
SAND PASPALUM	PAST	1.01	3.22	0.00	0.86	3.70	0.00
PURPLE THREE-AWN	ARPU	8.70	27.77	0.00	2.30	9.89	0.00
LOVEGRASS (SESSILISPICA)	ERSE	0.16	0.51	0.00	1.05	4.52	0.00
RED LOVEGRASS	EROX	0.72	2.30	0.00	0.00	0.00	0.00
GRASS COTYLEDON		0.04	0.13	0.00	0.00	0.00	0.00
ANNUAL FORBS							
TEXAS CROTON	CRTE	0.19	0.61	0.05	1.31	5.63	0.25
PRAIRIE SPURGE	EUMI	0.31	0.99	0.20	0.00	0.00	0.00
RIDGE-SEED SPURGE	EUGL	0.04	0.13	0.05	0.00	0.00	0.00
BINDWEED HELIOTROPE	HECO	0.00	0.00	0.00	0.22	0.95	0.15
ANNUAL WILD-BUCKWHEAT	ERAN	0.06	0.19	0.05	0.00	0.00	0.00
YELLOW WOOLLY-WHITE (BIENNL)	HYFL	0.12	0.38	0.05	0.00	0.00	0.00
ANNUAL SUNFLOWER	HEAN	0.42	1.34	0.05	0.06	0.26	0.05
GOLDEN CROWNBEARD	VEEN	0.06	0.19	0.05	0.00	0.00	0.00
ANNUAL GRASS							
FALSE BUFFALO GRASS	MUSQ	0.00	0.00	0.00	0.07	0.30	0.10

* ACRONYM: 4 letter abbreviation of the scientific name COVER: Foliar cover in percent FREQUENCY: Percent of sample DENSITY: Annual plants per square meter

TREE, SHRUB, CACTI, YUCCA	ACRO	* NORTHWEST 1 COVER	FREQ	DENS	* NORTHWEST 2 COVER	FREQ	DENS
HONEY MESQUITE	PRGL	0.00	0.00	0.00	0.02	0.06	0.00
SHINNERY OAK	QUHA	7.16	24.17	0.00	9.42	28.90	0.00
THREAD-LEAF SAGE WORT	ARFI	3.41	11.51	0.00	3.59	11.01	0.00
SOUTHWEST RABBITBRUSH	CHPU	0.16	0.54	0.00	0.12	0.37	0.00
YELLOW EVENING PRIMROSE	CASE	0.12	0.40	0.00	0.12	0.37	0.00
PLAINS YUCCA	YUCA	0.00	0.00	0.00	0.94	2.88	0.00
PLAINS PRICKLYPEAR	OPPO	0.00	0.00	0.00	0.04	0.12	0.00
PERENNIAL FORBS							
DUNE FLATSEDGE	CYON	0.00	0.00	0.00	0.12	0.37	0.00
SMOOTH OXYBAPHUS	OXGL	0.00	0.00	0.00	0.10	0.31	0.00
WOOLLY DALEA	DALA	0.00	0.00	0.00	0.30	0.92	0.00
THREADLEAF SENECIO	SELO	0.00	2.00	0.00	0.25	0.77	0.00
RIDDELL SENECIO	SESP	0.80	2.70	0.00	0.00	0.00	0.00
PERENNIAL GRASSES							
SANDBUR	CEIN	6.40	21.60	0.00	2.92	8.96	0.00
FALL WITCHGRASS	LECO	3.11	10.50	0.00	5.60	17.18	0.00
MESA DROPSEED	SPFL	0.12	0.40	0.00	0.00	0.00	0.00
GIANT DROPSEED	SPGI	2.87	9.69	0.00	1.19	3.65	0.00
LITTLE BLUESTEM	ANSC	0.00	0.00	0.00	1.87	5.74	0.00
SAND PASPALUM	PAST	1.04	3.51	0.00	1.20	3.68	0.00
PURPLE THREE-AWN	ARPU	4.50	15.19	0.00	1.94	5.95	0.00
BLACK GRAMA	BOER	0.00	0.00	0.00	0.57	1.75	0.00
LEHMANNS' LOVEGRASS	ERLE	0.00	0.00	0.00	0.30	0.92	0.00
LOVEGRASS (SESSILISPICA)	ERSE	0.06	0.20	0.00	0.00	0.00	0.00
GRASS COTYLEDON		0.00	0.00	0.00	0.02	0.06	0.00
ANNUAL FORBS							
TEXAS CROTON	CRTE	0.06	0.20	0.05	0.25	0.77	0.20
PRAIRIE SPURGE	EUMI	0.16	0.54	0.05	0.71	2.18	0.65
RIDGE-SEED SPURGE	EUGL	0.06	0.20	0.05	0.74	2.27	1.75
BINDWEED HELIOTROPE	HECO	0.12	0.40	0.05	0.00	0.00	0.00
ANNUAL WILD-BUCKWHEAT	ERAN	0.00	0.00	0.00	0.12	0.37	0.10
NEALLEY BEE-BLOSSOM	GASU	0.00	0.00	0.00	0.19	0.58	0.05
LIMONCILLO	PETE	0.19	0.64	0.05	0.00	0.00	0.00
ANNUAL GRASS							
FALSE BUFFALO GRASS	MUSQ	0.00	0.00	0.00	0.07	0.21	0.15

* ACRONYM: 4 letter abbreviation of the scientific name COVER: Foliar cover in percent FREQUENCY: Percent of sample DENSITY: Annual plants per square meter

Table 6-5
(Continued)
WIPP 1993 Fall Vegetation Report

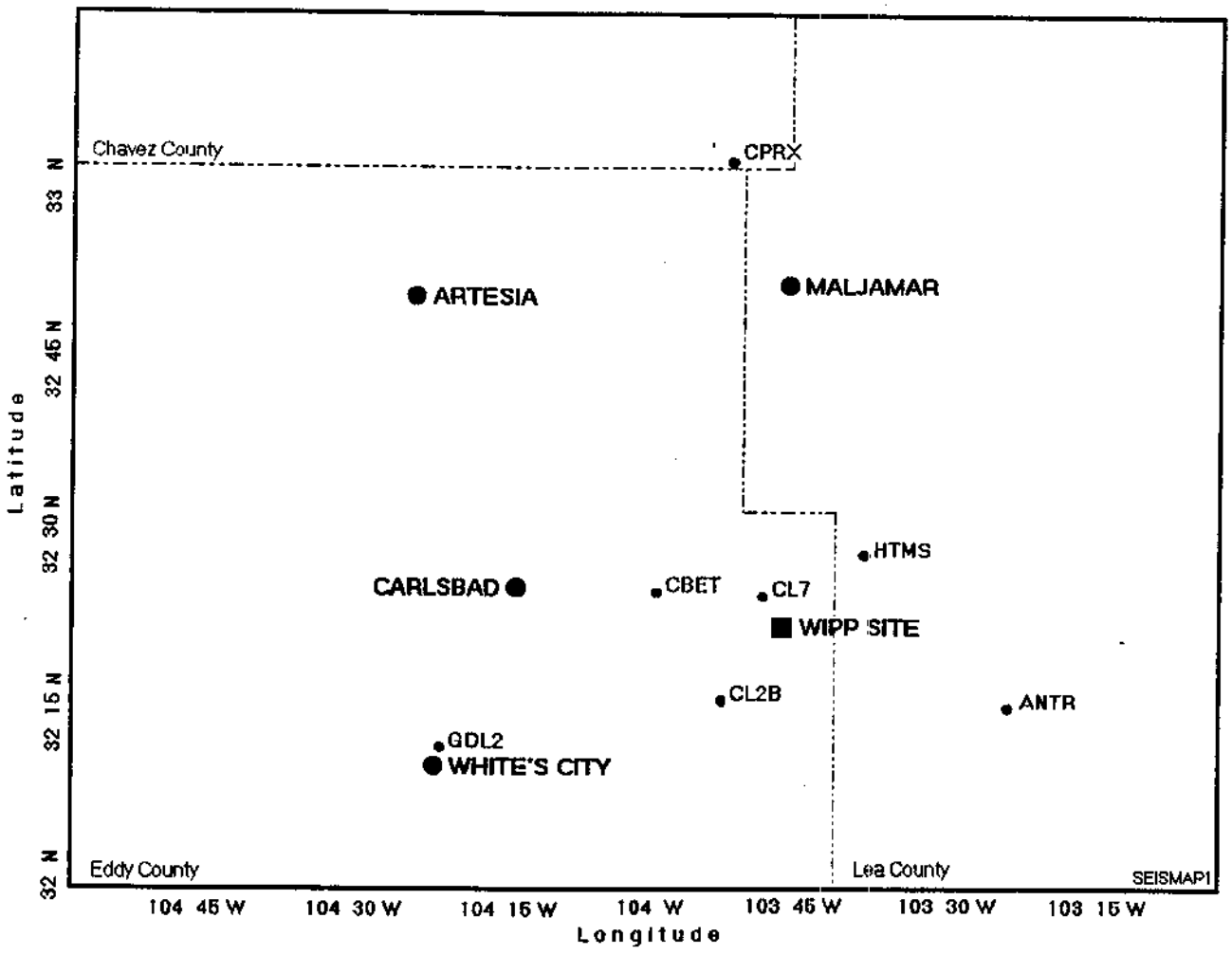
TREE, SHRUB, CACTI, YUCCA	ACRO	* SOUTHEAST 1 COVER	FREQ	DENS	COVER	* SOUTHEAST 2 FREQ	DENS
HONEY MESQUITE	PRGL	5.75	20.17	0.00	0.61	3.07	0.00
SHINNERY OAK	QUHA	7.44	26.10	0.00	7.96	30.16	0.00
THREAD-LEAF SAGE WORT	ARFI	2.97	10.42	0.00	3.54	13.41	0.00
PLAINS YUCCA	YUCA	0.00	0.00	0.00	1.79	6.78	0.00
PERENNIAL FORBS							
LEATHER-WEED CROTON	CRPO	0.06	0.21	0.00	0.00	0.00	0.00
SMOOTH OXYBAPHUS	OXGL	0.06	0.21	0.00	0.00	0.00	0.00
WOOLLY DALEA	DALA	0.06	0.21	0.00	0.19	0.72	0.00
SLENDER GREENTHREAD	THSI	0.19	0.67	0.00	0.00	0.00	0.00
THREADLEAF SENECIO	SELO	0.00	0.00	0.00	0.12	0.46	0.00
PERENNIAL GRASSES							
SANDBUR	CEIN	1.94	6.80	0.00	1.57	5.95	0.00
FALL WITCHGRASS	LECO	0.06	0.21	0.00	3.77	14.29	0.00
MESA DROPSEED	SPFL	1.56	5.47	0.00	0.00	0.00	0.00
GIANT DROPSEED	SPGI	0.44	1.54	0.00	1.10	4.17	0.00
LITTLE BLUESTEM	ANSC	0.56	1.96	0.00	0.00	0.00	0.00
SAND PASPALUM	PAST	0.35	1.23	0.00	0.70	2.65	0.00
PURPLE THREE-AWN	ARPU	3.70	12.96	0.00	3.10	11.75	0.00
BLACK GRAMA	BOER	0.00	0.00	0.00	0.22	0.83	0.00
LEHMANNS' LOVEGRASS	ERLE	0.04	0.14	0.00	0.00	0.00	0.00
LOVEGRASS (SESSILISPICA)	ERSE	0.06	0.21	0.00	0.00	0.00	0.00
RED LOVEGRASS	EROX	0.85	2.98	0.00	0.12	0.46	0.00
ANNUAL FORBS							
TEXAS CROTON	CRTE	0.25	0.86	0.05	0.06	0.23	0.05
PRAIRIE SPURGE	EUMI	0.42	1.47	0.20	0.25	0.95	0.10
RIDGE-SEED SPURGE	EUGL	1.30	4.56	2.25	0.35	1.33	0.30
BINDWEED HELIOTROPE	HECO	0.00	0.00	0.00	0.06	0.23	0.05
ANNUAL WILD-BUCKWHEAT	ERAN	0.00	0.00	0.00	0.40	1.52	0.25
WINGED PIGWEED	CYAT	0.19	0.67	0.05	0.00	0.00	0.00
NEALLEY BEE-BLOSSOM	GASU	0.00	0.00	0.00	0.06	0.23	0.05
LIMONCILLO	PETE	0.22	0.77	0.30	0.00	0.00	0.00
ANNUAL GRASS							
FALSE BUFFALO GRASS	MUSQ	0.04	0.14	0.05	0.22	0.83	0.10

* ACRONYM: 4 letter abbreviation of the scientific name COVER: Foliar cover in percent FREQUENCY: Percent of sample DENSITY: Annual plants per square meter

TREE, SHRUB, CACTI, YUCCA	ACRO	* EAST 1 COVER	FREQ	DENS
HONEY MESQUITE	PRGL	5.75	21.86	0.00
SHINNERY OAK	QUHA	5.90	22.43	0.00
THREAD-LEAF SAGE WORT	ARFI	1.75	6.65	0.00
PLAINS YUCCA	YUCA	3.03	11.52	0.00
PERENNIAL FORBS				
LEATHER-WEED CROTON	CRPO	0.41	1.56	0.00
WOOLLY DALEA	DALA	0.56	2.13	0.00
PLAINS BLACKFOOT	MELE	0.44	1.67	0.00
THREAD-LEAF BROOMWEED	XAMI	1.69	6.42	0.00
PERENNIAL GRASSES				
SANDBUR	CEIN	1.36	5.17	0.00
FALL WITCHGRASS	LECO	0.41	1.56	0.00
MESA DROPSEED	SPFL	0.62	2.36	0.00
SAND PASPALUM	PAST	0.54	2.05	0.00
PURPLE THREE-AWN	ARPU	3.22	12.24	0.00
HAIRY GRAMA	BOHI	0.12	0.46	0.00
PLAINS BRISTLEGRASS	SEMA	0.25	0.95	0.00
ANNUAL FORBS				
TEXAS CROTON	CRTE	0.06	0.23	0.05
PRAIRIE SPURGE	EUMI	0.16	0.61	0.15
RIDGE-SEED SPURGE	EUGL	0.04	0.15	0.05
ANNUAL GRASS				

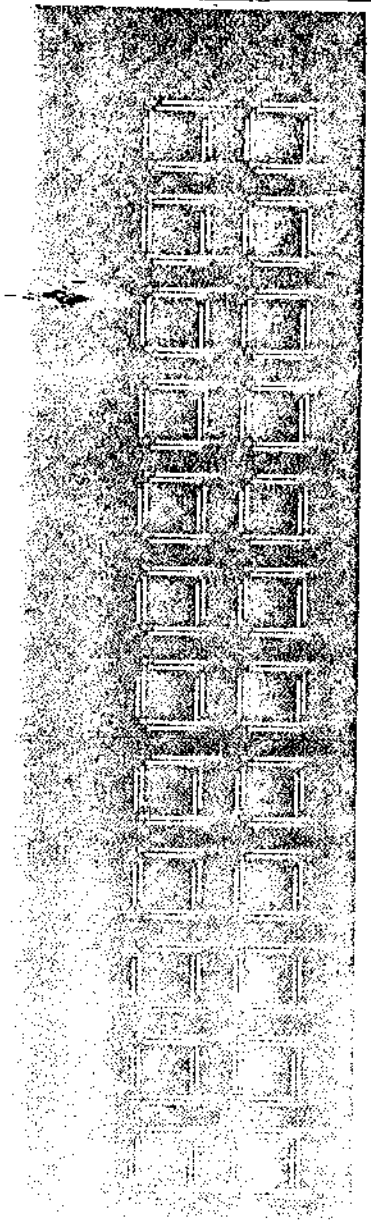
* ACRONYM: 4 letter abbreviation of the scientific name COVER: Foliar cover in percent FREQUENCY: Percent of sample DENSITY: Annual plants per square meter

Figure 6-3
WIPP Seismograph Station Locations



Definitions of Acronyms

ANTR - Antelope Ridge
CBET - Carlsbad East Tower
CL2B - Carlsbad Station 2B
CL7 - Carlsbad Station 7
CPRX - Caprock
GDL2 - Guadalupe Mountains
HTMS - Hat Mesa



CHAPTER 7

GROUNDWATER SURVEILLANCE

Chapter 7
Groundwater Surveillance

Current groundwater surveillance activities at the WIPP are outlined in the WIPP groundwater *Monitoring Program Plan and Procedure Manual* (WP 02-1, Rev 2). WP 02-1, Rev. 2, is a Quality Assurance document that contains program plans for each of the activities performed by groundwater surveillance personnel. Detailed procedures for performing specific activities such as pumping system installations, field parameter analysis, and document and QA records management are also contained in WP 02-1, Rev 2. Groundwater surveillance activities are also defined in the EMP.

The objective of the Groundwater Surveillance Program (GSP) is to determine the physical and chemical characteristics and maintain surveillance of groundwater levels of the groundwater surrounding the WIPP facility, both before and throughout the operational lifetime of the facility. The GSP also fulfills the requirements set forth in DOE Order 5400.1.

Background water quality data were collected from the 1985 through the 1990 sampling period. DOE/WIPP 92-013, "Background Water Quality Characterization Report for the Waste Isolation Pilot Plant," evaluates the background water quality data from the 1985 through the 1990 sampling period. This background data will be compared to water quality data collected throughout the operational life of the facility. Pre-operational data will be gathered in the interim period and utilized to strengthen the background data and to evaluate the need to make adjustments to comparison criteria. Data generated by groundwater surveillance programs are also useful in determining future regulatory needs and land use decisions, and in updating information for site documents such as the EMP.

The data obtained by the Water Quality Sampling Program (WQSP) in 1993 supported three major programs at the WIPP: (1) site characterization; (2) performance assessment (in compliance with 40 CFR 191); and (3) the EMP. Each of these programs requires a unique set of analyses and data, but overlap of analytical needs does occur. Particular sample needs are defined by each program. In addition to the characterization of groundwater the WQSP supported radionuclide monitoring for the Environmental Analysis and Compliance section of the WID. Results of radionuclide sampling are discussed in chapter 5 of this report. The NMED was on hand at each sampling event to collect samples for independent evaluation.

The WIPP is located within the Pecos Valley section of the Southern Great Plains physiographic province (Powers et al., 1978). The primary industries in the area that could contribute to pollution of the groundwater are local potash mining, gas and oil drilling, and cattle ranching. Geologic and lithologic descriptions of the area surrounding the WIPP site can be found in documents such as the

EMP, DOE/WIPP 90-008, *Groundwater Protection Management Program Plan*, or USGS 83-4016 (Mercer, 1983).

The rock units that were sampled in 1993 are in descending order; the Dewey Lake Redbeds and the Culebra dolomite. Fluids from these rock units have been collected either from wells at the WIPP or from privately owned wells (windmills). Groundwater sampling at WIPP focuses on the Culebra dolomite Member of the Rustler Formation. The Culebra dolomite is the most significant water bearing unit within the vicinity of the WIPP. No known hydrologic connection exists between the repository horizon and the Culebra dolomite. Surveillance of the characteristics of the water contained in the Culebra dolomite is beneficial to the WIPP because it provides data that can be used to determine if the characteristics of water in the Culebra are changing. It also provides additional data for use in hydrologic models designed to predict long-term performance of the repository (i.e., the Performance Assessment).

Groundwater surveillance activities during 1993 consisted of two separate programs: groundwater quality sampling and groundwater level measurements. Groundwater surveillance programs utilize 58 well bores to gather data. Six of these well bores are equipped with production inflated packers that allow groundwater to be sampled from more than one producing zone through the same well bore.

Groundwater quality data were gathered from 10 well locations. Data were collected at eight locations completed in the Culebra dolomite and from two privately owned wells in the vicinity of the WIPP that are completed in the Dewey Lake Redbeds.

The water quality sampling process has been developed around the logistics of using groundwater wells that were originally constructed for characterization and not for groundwater monitoring activities. The WIPP site has been given a conditional No-Migration Determination and is not required to have a monitoring program in compliance with the RCRA. The original wells are therefore being used for surveillance. Most of the wells are constructed with J-55 or K-55 iron casing. In order to decrease the sampling bias created by well construction deficiencies, combined with the low transmissibilities of the formations involved, a labor intensive sampling process has been initiated. Because of the time required to collect representative samples and because of the number of wells to be sampled, wells are sampled only once per year. A sampling episode is referred to as a "sampling round." Each yearly sampling round consists of the collection of two types of samples: serial samples and final samples. Serial samples are taken periodically, while the well is being purged. Data on key physical and chemical parameters (known as field parameters) are collected and compared to past serial sampling data until it is determined that a chemical steady state has been

reached. A chemical steady state is usually defined as +\- 5% of the average of the three to five preceding parameter measurements on the final day of serial sampling from previous sampling rounds. Stabilization of these field parameters is a function of purging and is used as an indicator to determine if the groundwater is representative of the zone being sampled. A final sample is collected once it has been determined that the pumped groundwater has achieved a representative state. This sample is sent off-site to a contract laboratory for analysis.

7.1 Groundwater Quality

Sampling for groundwater quality was performed at 10 well locations including two privately owned well sites during 1993 (Figure 7-1). With the exception of the two privately owned wells, each well was purged a minimum of 24 hours prior to the commencement of the serial sampling phase of the purging process. Field analyses for Oxidation Reduction Potential (Eh), pH, Specific Gravity, Specific Conductance, Alkalinity, Chloride, Divalent Cations, and Total Iron were performed on a periodic basis during serial sampling. These field parameters were used as indicators, during the purging process to better determine when the formation water being pumped had reached a representative state. Normally this process required seven to ten days to complete. Following the field analysis of the final serial sample, samples were collected and shipped to an independent, contract laboratory for analysis. Parameters of analyzed by the contract laboratory are listed in Table 7-1.

The total gallons of water removed from the Culebra dolomite member of the Rustler Formation during 1993 as a result of groundwater surveillance activity was approximately 22,732 gallons. The data from the final sample analyses show relative consistency when compared to background data. Tables 7-2 through 7-9 contain average results of data collected from the Culebra dolomite during 1993 as compared to background data for major constituents of the background matrix. None of the waste stream Volatile Organic Compounds for which analyses were run showed any detectable concentrations.

Water quality of the Culebra in the vicinity of the WIPP is naturally poor and the waters are not suitable for human consumption or for agricultural purposes. The waters contain naturally high concentrations of total dissolved solids and mineral constituents, primarily chloride, calcium, magnesium, sodium and potassium (Mercer, 1983). Although a number of wells within the vicinity of WIPP contain less than 10,000 mg/l Total Dissolved Solids (TDS) the chloride and sulfate concentrations in these wells are well above limits set by water quality standards. The generally poor quality of the waters has historically posed a problem when it comes to analyzing these waters because it tends to interfere with the performance of standard laboratory equipment such as the Atomic Absorption or the Inductive Coupled Atomic Plasma, causing detection limits to be inconsistent.

The only usable water in the area of the WIPP is from wells completed in the Dewey Lake Redbeds, which produce water from discontinuous saturated zones of thin lenticular sands that are believed to be locally recharged (Mercer 1983). The water quality of the Dewey Lake Redbeds are generally considered to be fresh water, suitable for agricultural purposes and marginal for human consumption. Two wells were sampled in the Dewey Lake Redbeds, these were: Ranch well, located approximately 3 and 2 tenths miles south of the WIPP site, and Barn well, located approximately 3 and 4 tenths miles south of the WIPP site. Each of these wells showed elevated levels of nitrate in the groundwater analysis. Ranch well showed the highest average concentration (16.9 mg/l) and the Barn well concentration was 10.5 mg/l. The most probable source of these nitrate concentrations are the large numbers of livestock that utilize these wells for drinking water. A comparison of 1993 analytical data results to background data are presented in Tables 7-10 and 7-11 for data collected from the Dewey Lake formation.

7.2 Groundwater Level Surveillance

In October 1988, WID was tasked with conducting a groundwater level surveillance program in the area of the WIPP site. Fifty-eight well bores were used to sample six water bearing zones in the WIPP area. The two zones of primary interest were the Culebra dolomite and Magenta dolomite members of the Rustler Formation: forty-six measurements were taken in the Culebra dolomite and 11 measurements were taken in the Magenta dolomite. Two measurements were taken in the Rustler/Salado contact and Dewey Lake formation; one measurement each was taken in the Bell Canyon, the Forty-niner and the Unnamed Lower Member. Locations of groundwater-level surveillance sites are pictured in Figure 7-2.

Groundwater elevation measurements in the Culebra dolomite indicate that the generalized directional flow of groundwater is north to south in the vicinity of WIPP (Figure 7-3). However, caution should be used when making assumptions based on groundwater-level data alone; studies in the Culebra dolomite have shown that fluid density variations in the Culebra dolomite can affect flow direction (Crawley, 1988 and Davies, 1989). One should also be aware that the fractured media of the Culebra dolomite coupled with variable fluid densities can cause localized flow patterns to have little or no relationship to general flow patterns (Mercer, 1983 and Crawley, 1988).

Groundwater flow directions in the Magenta dolomite appear to be generally from an east to west direction across the WIPP site (Figure 7-4). Studies have not been performed to determine spacial variations in the fluid densities in the Magenta dolomite to the same magnitude as those the Culebra dolomite. It is very possible if not likely that density variations do occur in the Magenta dolomite. Therefore, the potential may exist that to some extent flow patterns in the Magenta dolomite may be

affected by variations in fluid density. Also flow through the fractured media of the Magenta dolomite may well dictate the behavior of localized flow patterns.

Groundwater level measurements taken in 1993 show a general trend toward rising water levels. The increase in water levels may be attributed to the natural recovery of water bearing formations near the WIPP to levels near those noted by Mercer in 1983. Mercer's 1983 report was produced prior to the onset of large-scale pumping tests that removed huge volumes of water from the Magenta and Culebra members of the Rustler Formation from 1984 through 1988. Also, the grouting of the four shafts that provide access to the WIPP underground has recently been completed, sealing off the inflow of water from these formations into the shaft area. Significant recovery of the Magenta and Culebra members in the immediate vicinity of the WIPP will probably occur in CY 1994 due to the completion of the grouting process.

Table 7-1
Parameters Analyzed During Calendar Year 1993

Specific Conductance	Boron
Sulfate	Cadmium
Total Dissolved Solids	Calcium
Total Suspended Solids	Chromium
Density	Iron
pH	Lead
Alkalinity	Lithium
Bromide	Magnesium
Chloride	Mercury
Fluoride	Potassium
Iodide	Selenium
Nitrogen, NO_3 (AS N)	Silica
Total Organic Carbon	Silver
Total Organic Halogens	Sodium
Phenol, Total	Carbon Tetrachloride
Orthophosphate (AS P)	Methylene Chloride
Arsenic	Trichloroethylene
Barium	1,1,1-Trichloroethane
Beryllium	Freon-113

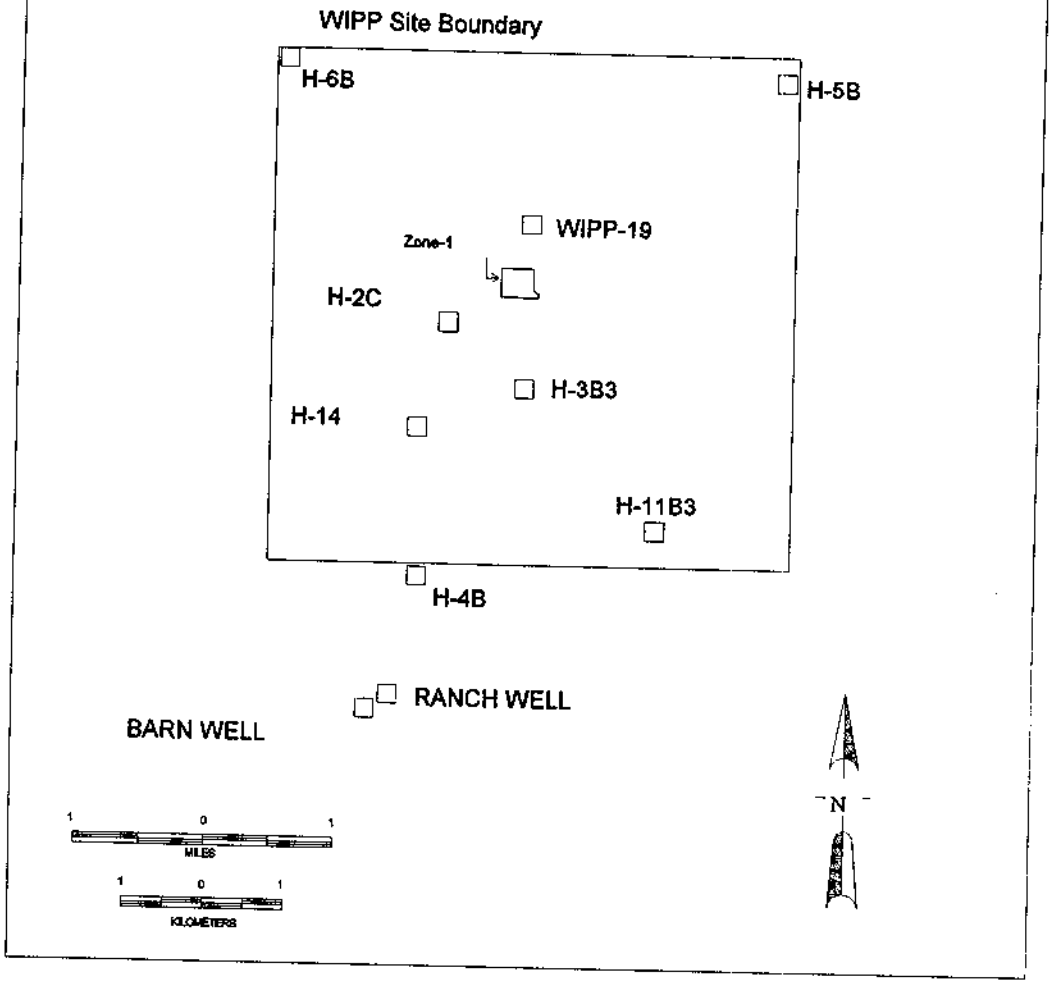


FIGURE 7-1

WATER QUALITY SAMPLING PROGRAM

SAMPLE WELLS 1993

Table 7-2
H-02c, Culebra
Round 5 Comparison To Background Characterization

Parameter	1993 Average Concentration (mg/l)	Background Concentration Interval (mg/l)
Boron	9.75	9-12
Calcium	603	589-841
Iron	0.37	0-1.9
Lithium	0.229	0.26-0.72
Magnesium	185	152-181
Potassium	86	86-119
Sodium	1,775	0-5,270
Alkalinity	45.2	52-60
Bromide	9.17	0-5
Chloride	3,060	2,396-6,737
Fluoride	2.21	2.1-2.2
pH	7.38	7.38-8.04
Sulfate	2,700	2,061-3,806
Total Dissolved Solids	9,285	7,612-15,689
Arsenic	<0.003	≤0.014
Barium	0.006	<0.05
Beryllium	<0.0025	<0.05
Cadmium	<0.0025	≤0.08
Chromium	<0.01	≤0.4
Lead	<0.025	≤0.5
Mercury	<0.002	<0.0002
Selenium	<0.002	<0.05
Silica	12	6.1-14
Silver	<0.025	≤0.20
Iodide	<1.0	1-9
Nitrate as (N)	<0.10	≤0.30
Phenolics	<0.1	≤0.097
Phosphate AS (P)	<0.02	≤0.03
Total Organic Carbon	1.26	5-7
Total Organic Halogen	0.0166	≤0.14

Table 7-3
H-03b3, Culebra
Round 8 Comparison To Background Characterization

Parameter	1993 Average Concentration (mg/l)	Background Concentration Interval (mg/l)
Boron	22.5	19-32
Calcium	1,210	1,193-1,527
Iron	0.36	0.14-0.47
Lithium	0.54	0.15-0.82
Magnesium	621	710-826
Potassium	448	372-534
Sodium	12,100	16,140-17,900
Alkalinity	41	46-54
Bromide	26.6	7-41
Chloride	27,600	26,742-30,838
Fluoride	1.27	1.5-1.6
pH	7.32	6.85-7.66
Sulfate	5,275	4,537-4,823
Total Dissolved Solids	52,500	53,130-55,170
Arsenic	<0.003	<0.10
Barium	<0.005	≤0.06
Beryllium	<0.028	≤0.15
Cadmium	0.002	≤0.07
Chromium	<0.005	0.007-0.4
Lead	<0.016	≤0.50
Mercury	<0.0002	<0.001
Selenium	<0.003	<0.50
Silica	9.83	4.5-13
Silver	<0.013	≤0.10
Iodide	<1.0	<2.0
Nitrate as (N)	<0.10	<0.20
Phenolics	<0.10	≤0.033
Phosphate AS (P)	<0.02	≤0.06
Total Organic Carbon	0.70	≤2.0
Total Organic Halogen	0.048	0.14-0.42

Table 7-4
H-04b, CULEBRA
Round 8 Comparison To Background Characterization

Parameter	1993 Average Concentration (mg/l)l	Background Concentration Interval (mg/l)
Boron	14.2	14-21
Calcium	669	604-741
Iron	<1.00	0.40-0.55
Lithium	0.398	0.25-0.58
Magnesium	339	385-468
Potassium	173.5	179-261
Sodium	5,270	5,625-6,255
Alkalinity	49.4	51-72
Bromide	40.3	31-83
Chloride	7,350	1,968-12,099
Fluoride	1.82	1.7-2.2
pH	7.27	6.30-7.82
Sulfate	6,300	4,447-6,513
Total Dissolved Solids	20,600	17,010-23,050
Arsenic	<0.003	<0.10
Barium	<0.02	<0.10
Beryllium	<0.01	<0.05
Cadmium	0.0045	<0.005
Chromium	<0.01	<0.30
Lead	0.0278	<0.05
Mercury	<0.0002	<0.0017
Selenium	<0.005	<0.05
Silica	11.6	5.6-14
Silver	0.11	<0.10
Iodide	<1.14	<2.0
Nitrate AS (N)	<0.20	<0.10
Phenolics	<0.10	<0.026
Phosphate AS (P)	<0.02	<0.03
Total Organic Carbon	0.59	3.0-5.0
Total Organic Halgen	0.0198	0.06-0.64

TABLE 7-5
H-05b, CULEBRA
Round 8 Comparison To Background Characterization

Parameter	1993 Average Concentration (mg/l)	Background Concentration Interval (mg/l)
Boron	27.1	28-35
Calcium	1,305	1,205-1,875
Iron	1.38	1.8-3.2
Lithium	0.84	0.6-1.3
Magnesium	1,670	1,586-2,094
Potassium	883	1,014-1,362
Sodium	41,200	44,526-55,955
Alkalinity	30.9	39-47
Bromide	68.1	24-99
Chloride	84,500	84,085-91,835
Fluoride	0.77	0.7-1.2
pH	7.08	6.88-7.11
Sulfate	8,595	5,914-7,646
Total Dissolved Solids	149,500	142,508-164,093
Arsenic	<0.006	<0.1
Barium	<0.02	<0.5
Beryllium	<0.01	<0.05
Cadmium	<0.0006	<0.11
Chromium	<0.0025	<0.3
Lead	0.009	<1.0
Mercury	<0.002	<0.0005
Selenium	<0.006	<7.3
Silica	5.99	<21
Silver	<0.0063	<0.1
Iodide	3.61	<2.0
Nitrate AS (N)	0.10	<0.4
Phenolics	<0.10	<0.51
Phosphate AS (P)	<0.02	<0.13
Total Organic Carbon	3.79	<4.0
Total Organic Halogen	0.059	<7.6

Table 7-6
H-06b, Culebra
Round 8 Comparison To Background Characterization

Parameter	1993 Average Concentration (mg/l)	Background Concentration Interval (mg/l)
Boron	11.4	7.7-10.7
Calcium	2,140	1,702-2,138
Iron	<2.40	0.2-0.6
Lithium	<0.68	0.3-0.7
Magnesium	1,009	791-1,085
Potassium	356	330-556
Sodium	17,450	14,230-17,710
Alkalinity	80	91-101
Bromide	36.7	12-62
Chloride	31,550	28,816-34,462
Fluoride	1.28	1.2-1.5
pH	6.87	6.18-7.37
Sulfate	5,220	3,093-3,527
Total Dissolved Solids	61,450	56,831-64,569
Aresenic	<0.005	<0.5
Barium	<0.09	<0.1
Beryllium	<0.055	0.05
Cadmium	<0.002	<0.05
Chromium	<0.003	0.22-0.45
Lead	<0.01	≤0.83
Mercury	<0.001	≤0.0012
Selenium	<0.005	≤1.3
Silica	17.4	8.3-25
Silver	<0.004	≤0.1
Iodide	<1.0	<2.0
Nitrate AS (N)	<0.25	≤0.2
Phenolics	<0.10	0.004-0.016
Phosphate AS (P)	<0.02	≤0.02
Total Organic Carbon	1.94	≤7.0
Total Organic Halogen	0.29	0.16-3.0

Table 7-7
H-11b3, Culebra
Round 7 Comparison To Backround Characterization

Parameter	1993 Average Concentration (mg/l)	Background Concentration Interval (mg/l)
Boron	27.1	29-31
Calcium	1,145	1,329-1,655
Iron	1.41	<1.0
Lithium	0.979	0.5-0.6
Magnesium	848	1,038-1,272
Potassium	1,010	654-990
Sodium	28,650	35,169-45,432
Alkalinity	42.6	44-58
Bromide	48.4	18-90
Chloride	64,000	57,063-72,497
Fluoride	<.50	1.0-1.2
pH	7.39	6.95-7.22
Sulfate	7,405	5,843-7,397
Total Dissolved Solids	114,500	113,705-123,095
Arsenic	<0.003	<0.15
Barium	0.014	<0.10
Beryllium	0.004	<0.05
Cadmium	<0.0013	0.06-0.09
Chromium	<0.005	0.32-.40
Lead	0.018	<0.60
Mercury	<0.002	<0.0004
Selenium	<0.003	<0.50
Silica	5.84	4.1-15
Silver	0.019	0.1-0.2
Iodide	1.15	<2.0
Nitrate AS (N)	<1.0	<0.30
Phenolics	<0.10	<0.02
Phosphate AS (P)	<0.02	<0.04
Total Organic Carbon	1.63	<3.0
Total Organic Halogen	0.069	<1.5

Table 7-8
H-14, Culebra
Round 6 Comparison To Background Characterization

Parameter	1993 Average Concentration mg/l	Background Concentration Interval mg/l
Boron	9.06	11
Calcium	1,655	1,504-2,129
Iron	1.56	0.1-0.8
Lithium	0.396	039-0.56
Magnesium	515	451-613
Potassium	211	233-257
Sodium	2,955	2,750-4,184
Alkalinity	28.2	35-43
Bromide	13.6	9-18
Chloride	9,050	6,954-9,779
Fluoride	2.22	0.1-2.6
pH	7.53	5.89-8.50
Sulfate	2,025	1,209-2,291
Total Dissolved Solids	18,100	14,066-19,867
Arsenic	<0.003	<0.05
Barium	0.012	<0.05
Beryllium	<0.0027	<0.05
Cadmium	0.0015	<0.06
Chromium	<0.005	0.2-0.4
Lead	<0.0132	<0.5
Mercury	<0.002	<0.0004
Selenium	<0.003	<0.05
Silica	10.95	5.5-14
Silver	<0.013	<0.1
Iodide	1.67	<2.0
Nitrate as (N)	<.20	<0.40
Phenolics	<0.10	0.068-0.14
Phosphate AS (P)	<0.02	<0.05
Total Organic Carbon	1.07	<2.0
Total Organic Halogen	0328	0.08-1.1

Table 7-9
WIPP-19, Culebra
Round 8 Comparison To Background Characterization

PARAMETER	1993 AVERAGE CONCENTRATION mg/l	BACKGROUND CONCENTRATION INTERVAL mg/l
Boron	27.8	27-34
Calcium	1,385	1,441-1,919
Iron	1.95	<2.0
Lithium	0.45	0.3-1.1
Magnesium	917	961-2,239
Potassium	508	565-913
Sodium	22,900	23,962-32,658
Alkalinity	46.0	51-70
Bromide	41.1	22-126
Chloride	41,850	33,201-54,520
Fluoride	1.04	0.8-1.1
pH	7.05	6.75-7.33
Sulfate	5,560	5,097-5,763
Total Dissolved Solids	75,650	68,389-103,151
Arsenic	<0.003	<0.5
Barium	<0.02	<0.50
Beryllium	<0.01	<0.50
Cadmium	<0.001	<0.50
Chromium	<0.003	<2.0
Lead	<0.01	<5.0
Mercury	<0.05	<0.002
Selenium	<0.003	<0.50
Silica	8.18	<4.40
Silver	<0.01	<1.0
Iodide	2.06	<2.0
Nitrate AS (N)	<0.25	<0.12
Phenolics	<0.1	<0.019
Phosphate AS (P)	<0.02	<0.03
Total Organic Carbon	2.64	2-7
Total Organic Halogen	133	0.57-3.2

Table 7-10
Barn Well, Dewey Lake
Round 7 Comparison To Background Characterization

Parameter	1993 Average Concentration mg/l	BACKGROUND CONCENTRATION INTERVAL mg/l
Calcium	52.4	47-85
Manganese	<0.13	<0.015
Sodium	80.9	74-142
Alkalinity	200	262-291
Chloride	36.0	32-49
Fluoride	1.87	2.5-2.7
pH	7.10	6.37-8.17
Sulfate	141	167-246
Total Dissolved Solids	545	606-729
Aresnic	<.003	<0.05
Barium	0.026	<0.2
Cadmium	<0.006	<0.005
Chromium	<0.01	≤0.02
Copper	<0.025	≤0.03
Lead	<0.25	<0.05
Mercury	<0.002	<0.0002
Selenium	<0.002	<0.05
Silver	0.0275	<0.01
Zinc	<0.05	≤0.03
Nitrate AS (N)	10.45	7.1-9.6
Phenolics	<0.10	<0.008
Total Organic Carbon	0.865	≤4.0
Total Organic Halogen	0.08	≤0.15

Table 7-11
Ranch Well, Dewey Lake
Round 8 Comparison To Background Characterization

Parameter	1993 Average Concentration mg/l	Background Concentration Interval mg/l
Calcium	601	283-397
Magnesium	<0.013	<0.015
Sodium	182	115-270
Alkalinity	143	215-256
Chloride	268	318-470
Fluoride	1.17	0.7-1.5
pH	7.31	6.75-7.58
Sulfate	1575	700-1299
Total Dissolved Solids	3580	2818-3302
Arsenic	<0.003	<0.01
Barium	0.0060	<0.20
Cadmium	0.003	≤0.01
Chromium	<0.01	≤0.07
Copper	<0.025	<0.025
Lead	<0.026	≤0.08
Mercury	<0.002	≤0.0008
Selenium	<0.002	≤0.079
Silver	<0.025	≤0.02
Zinc	<0.05	0.02-0.16
Nitrate AS (N)	16.9	110-120
Phenolics	<0.1	≤0.022
Total Organic Carbon	0.19	3-4
Total Organic Halogen	0.045	≤0.4

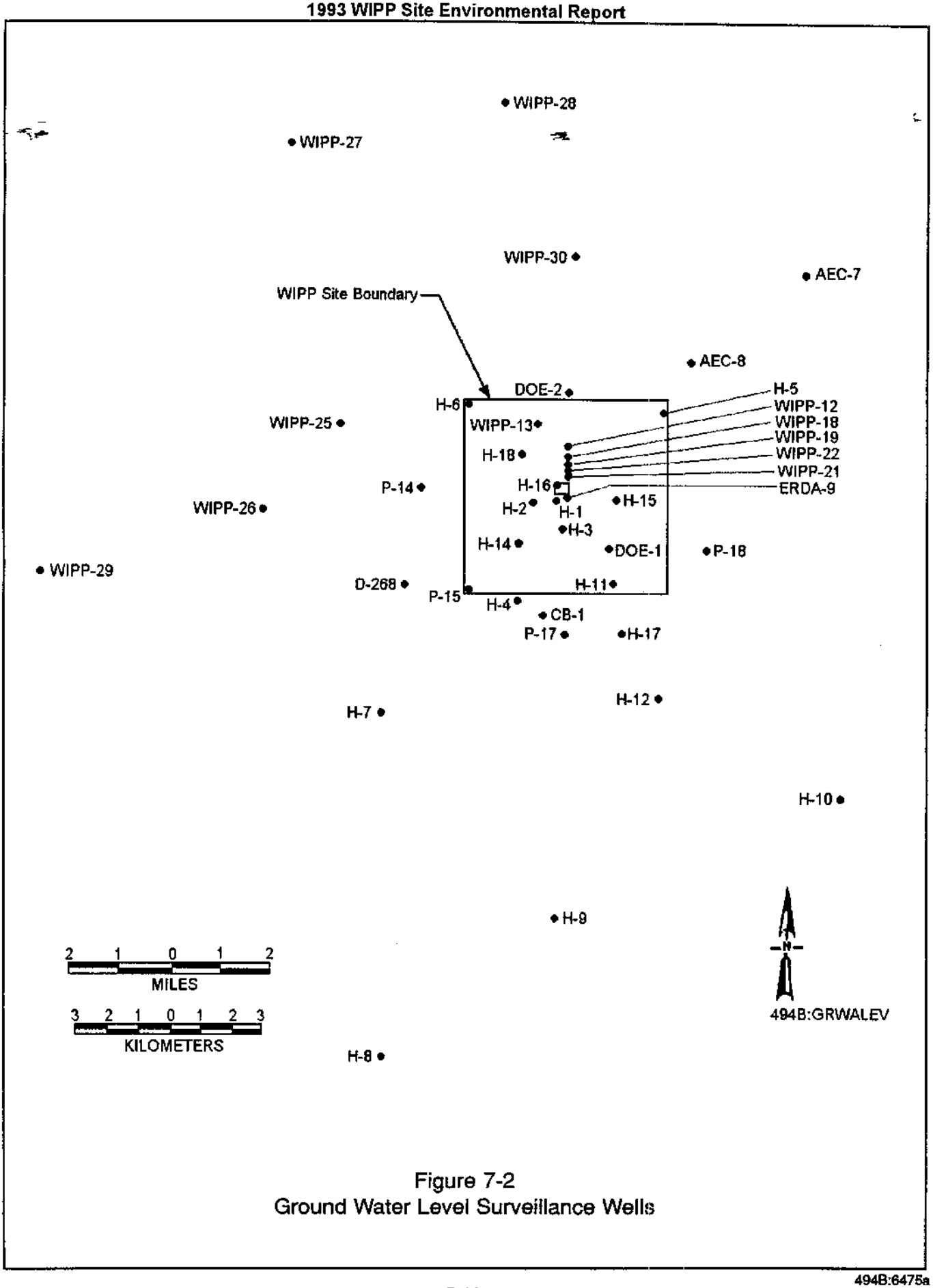


Figure 7-2
Ground Water Level Surveillance Wells

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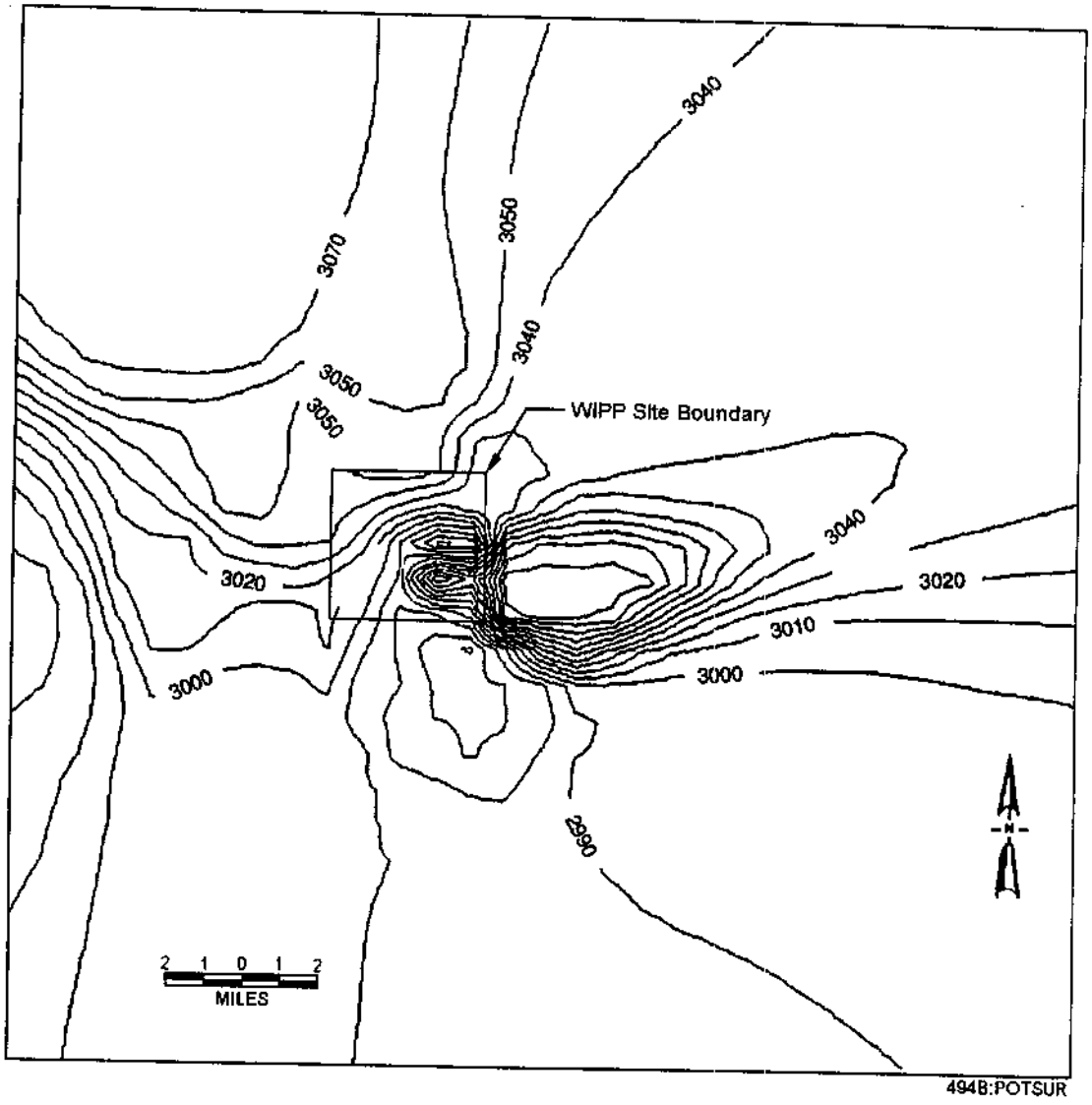

Figure 7-3
Potentiometric Surface of the Culebra Dolomite Member
of the Rustler Formation near the WIPP Site

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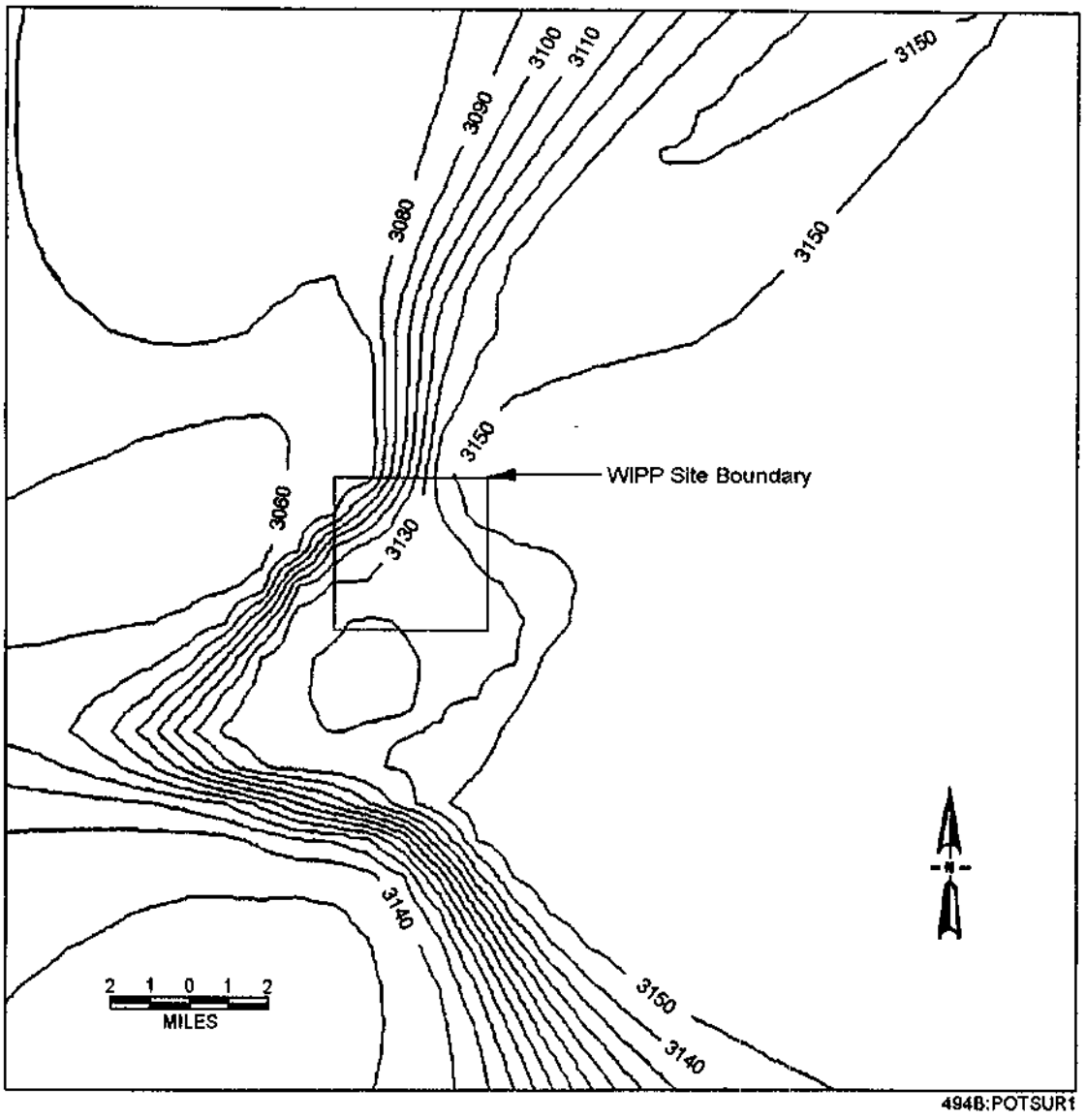
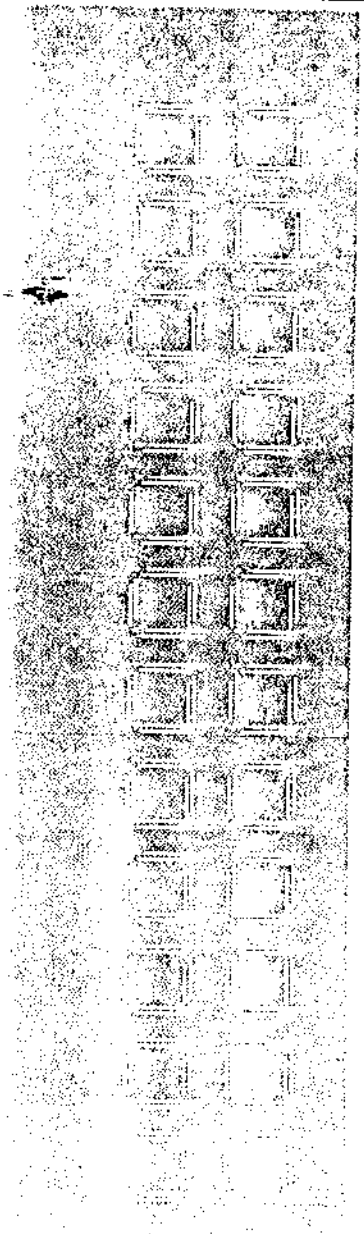


Figure 7-4
Potentiometric Surface of the Magenta Dolomite Member
of the Rustler Formation near the WIPP Site as of 12-93



CHAPTER 8

QUALITY ASSURANCE

Chapter 8
Quality Assurance

This chapter outlines the Quality Assurance/Quality Control goals and procedures for the radiological and nonradiological monitoring programs at the WID and at the off-site subcontractor laboratories. The purpose of the program is to monitor the reliability, accuracy, and precision of all data, and to detect and correct problems in the sample collection, preparation, analysis, and the data evaluation phases.

QA comprises all of the planned and programmed events undertaken to ensure the validity of the results of the monitoring program. Included in the QA Program is the QC task specific and provides a context for assessing the performance of equipment, instruments, and procedures. The QA/QC program for the WIPP environmental programs is established within the framework of the overall *Quality Assurance Program Manual* of the Westinghouse Electric Corporation, Waste Isolation Division.

A comprehensive QA program has been implemented to ensure that the data collected reflect actual concentrations in the environment and have been obtained prior to commencement of operations. In other words, these data must provide a sound baseline for comparison with operational-phase data that reflect potential impacts of the WIPP. The focus of this program includes:

Collect samples at all locations according to procedures based on accepted practices and widely recognized methodologies and criteria

Review and revise procedures as appropriate to minimize uncertainty due to sampling error while maintaining comparability and continuity between past and future data

Verify data through a continuing program of analytical laboratory quality control, including the performance of inter-laboratory cross-checks, duplicate sample/split radiological analysis, and sample splits provided to the EEG, and NMED.

Adherence to policies set forth by federal QA regulations include the following: ASME NQA-1, *Quality Assurance Program Requirements for Nuclear Facilities* (ASME, 1989); EPA; QAMS-005/80, *Interim Guidelines and Specifications for Preparing Quality Assurance Project Plans* (EPA, 1980); DOE Orders 5400.1 (DOE, 1990d), 5400.3 (DOE, 1989), 5700.6C (DOE, 1991); and the *Environmental Regulatory Guide for Radiological Effluent Monitoring and Environmental Surveillance* (DOE/EH-0173T, 1991).

Adherence to policies set forth by federal QA regulations include the following: ASME NQA-1, *Quality Assurance Program Requirements for Nuclear Facilities* (ASME, 1989); EPA; QAMS-005/80, *Interim Guidelines and Specifications for Preparing Quality Assurance Project Plans* (EPA, 1980); DOE Orders 5400.1 (DOE, 1990d), 5400.3 (DOE, 1989), 5700.6C (DOE, 1991); and the *Environmental Regulatory Guide for Radiological Effluent Monitoring and Environmental Surveillance* (DOE/EH-0173T, 1991).

8.1 Sample Collection Methodologies

Written procedures are important because they not only provide guidance to field personnel for samples collected in the field but also form the basis of an auditable program. To ensure compliance with the written procedures, the QA Department periodically conducts surveillance, inspection, and internal audits. An inspection report surveys personnel performance in one activity. A surveillance assesses a procedure according to specifications and standards described in WP 13-011. An internal audit, which is a more comprehensive investigation, evaluates the adequacy and effectiveness of the QA program's implementation, related procedure's, and practices. An audit may include review of procedures, file management, and test equipment. Audits are conducted according to WP 13-005.

Sampling procedures are contained in the following documents:

WIPP Groundwater Monitoring Program Plan and Procedure Manual (WP 02-1)
WIPP Environmental Procedures Manual (WP 02-3)
WID Quality Assurance Program Description (WP 13-1, Rev. 14)

Sampling procedures describe the methods for determining sample location, the timing of collection, equipment calibration, shipment method, and the specific steps to be taken for sample collection, analysis, and shipment. The sampling procedures also provide program requirements for data entry, sample tracking, and record-keeping. These procedures ensure that the data collected and entered accurately reflect conditions at the WIPP site. Standard sample location codes are used for reporting results for all environmental programs.

The current guiding document provides details on the sampling procedures and cites the document containing those procedures. Chapter 11 of the EMP defines the policies and practices that are followed to ensure the data are accurate, complete, representation, and comparable.

The data collected in the NES monitoring programs are analyzed as stated in DOE/EH-0023 (Corley et al., 1981). Section 8.0 of the EMP discusses at length the statistical procedures used to analyze the data.

Following the policies and procedures outlined in the various documents above, the WIPP conducted one internal audit and seven QA surveillances in 1993 on the environmental programs at the WIPP. These evaluations resulted in seven program deficiency reports (PDRs) being issued. To date, six of the PDRs have been closed out and the final PDR will be closed out in September 1994.

8.2 Revision of Procedures

One of the responsibilities of data collection personnel is to assess collection and analysis methodologies. Field procedures, analytical procedures, and laboratory methodologies are periodically scrutinized for adequacy. Procedures and methodologies that require modification are modified according to the criteria set forth in WP 15-101. Additionally, radiological samples are split with the EEG and the NMED to act as a check that procedures are adequate and that data results are comparable among the WIPP, the EEG, and the NMED samples. All procedure manuals are reviewed regularly, updated, and expanded as necessary.

8.3 Interlaboratory Comparisons

The WIPP Low-Level Counting Laboratory (LLCL) participated in the DOE Environmental Measurements Laboratory (EML) Quality Assessment Program (QAP). The DOE-EML QAP not only provides an external method of ensuring the quality of LLCL analysis, but also provides a method for demonstrating the LLCL's analytical capabilities.

The EML measures its performance as the ratio of a laboratory's reported results to its results. Results are categorized as falling within the accepted ratio range of 0.8-1.2, 0.5-1.5 and, outside the accepted ratio range (0.5-1.5). The LLCL fell within the accepted 0.8-1.2 range for all analytical results reported.

Only analysis of water and air filters for gamma emitting nuclides was performed due to the lack of sample preparation facilities at the WIPP site. The WIPP is in the process of obtaining a modular sample preparation laboratory. Once the laboratory is installed the WIPP will have the on-site capability to perform actinide analysis and preparation of sample matrix other than water and air filters. The WIPP anticipates participation in the DOE-EML QAP for more variety of sample matrices will further demonstrate the analytical abilities of the LLCL.

The WIPP was accepted for participation in the Environmental Protection Agency Intercomparison Program in the fall of 1993. This program will serve as an additional method of ensuring the quality of the analyses performed by the LLCL.

8.4 Laboratory Quality Control

During CY93 the WIPP extended contracts to the following analytical laboratories:
Ross Analytical Services Inc. in Strongsville, Ohio, and Accu-Labs. in Golden, Colorado.

These laboratories must adhere to and provide evidence of the following compliance with the ASME NQA-1:

Routine calibration of instruments

- Frequent source and background counts (as appropriate)
- Routine yield determinations of radiochemical procedures
- Replicate/duplicate, and blank analyses to check precision
- Analyses of reagents to ensure chemical purity that could affect the results of the analytical process
- Each laboratory will have a written and implemented QA program that utilizes standard analysis methods for each parameter studied.
- Participation in interlaboratory cross-checks can reveal outdated, previously acceptable lab procedures that are currently unsuitable or inadequate. Steps are then taken to find updated methodologies. The laboratories providing chemical analytical services for the WIPP are required to participate in interlaboratory cross-checks conducted by the EPA.

8.5 Record Keeping

Records generated in support of the EMP are controlled and maintained in accordance with DOE Order 1324.2A, *Records Description* (DOE, 1992), and *WIPP Records Management Procedures* (WP 15-030). All original records are maintained in fire resistant file cabinets until they are transmitted to the WIPP Project Records Services (PRS) for permanent filing (WP 15-030). All records including raw data, calculations, computer programs, or other data manipulation media are subject to review and verification under the WIPP Quality Assurance Program. The Environmental Monitoring Section is responsible for validating of these records before transmitting them to the PRS center in accordance with the Records Inventory Disposition Schedule.

Records (i.e., reports of analyses and sample receipt forms transmitted by contract analytical laboratories) are dated upon receipt and a copy made for QC review as specified in *NES/RES QA/QC Implementation Procedures* (WP 02-302). Specific record and data management procedures including those referencing data manipulations are implemented according to the WIPP Groundwater

Monitoring Program Plan and Procedures Manual, "RES Data Management Procedure" (WP 02-305), and *NES Data Management Procedure* (WP 02-334).

The WIPP complies with record-keeping requirements issued under 40 CFR Part 61, Subpart H (EPA, 1985B), which pertain to atmospheric radionuclide emissions (WP 02-301). In addition unless regulations are amended in the future, records development pursuant to these criteria (i.e., Medical, Health and Safety Records) will be maintained at least 30 years as specified in DOE 1324.2A (DOE, 1992), Chapter V, Attachment 1, Schedule 25.

Consistent record-keeping in all aspects of the Environmental Monitoring Programs are a part of QA requirements. Section 10 of the EMP lists of the required records and reports and the laws, regulations, or DOE Orders that contain the requirements. Records are maintained in accordance with WP 15-030, Records Management.

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CHAPTER 9

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Chapter 9
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CHAPTER 10

REQUIRED DISTRIBUTION LIST

Chapter 10
Required Distribution List

WIPP Public Reading Room
National Atomic Museum
Albuquerque Operations Office
P.O. Box 5400
Albuquerque, NM 87115

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101 S. Halagueno St.
Carlsbad, NM 88220

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New Mexico Junior College
5317 Lovington Highway
Hobbs, NM 88240

Ms. Elisa Monnet
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Organization 6332
P.O. Box 5800
Albuquerque, NM 87185

Ms. Norma McCallum
New Mexico State Library
325 Don Gaspar
Santa Fe, NM 87503

Raton Public Library
244 Cook Avenue
Raton, NM 87740

Ms. Joan Ogbazghi
DOE/Forrestal Bldg.
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SNL Technical Library
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Albuquerque, NM 87185

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Albuquerque, NM 87138

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Oak Ridge, TN 37830

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Albuquerque, NM 87109

Mr. J. Kenney
Environmental Evaluation Group
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Carlsbad, NM 88220

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Roswell, NM 88201

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Albuquerque, NM 87138
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3-G 092/FORS
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Washington, D.C. 20585

EM-34
323 Trevion
12800 Middlebrook Rd
Germantown, MD 20874

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Region VI
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1445 Ross Avenue
Dallas, TX 75202-2733

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Albuquerque Field Operations Office
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Pennsylvania and H Street
Albuquerque, NM 87185-5400

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Carlsbad, NM 88221-3090

Judith M. Espinosa, Sec.
Harold Runnels Building
1190 St. Francis Drive
P.O. Box 26110
Santa Fe, NM 87502

Neil Weber
New Mexico Environment Department
1190 St. Francis Drive
P.O. Box 26110
Santa Fe, NM 87502

Carlsbad Environmental
Monitoring & Research Center
Attention: Director
800 W. Pierce St.
Carlsbad, NM 88220

University of California at Los Angeles
Wootyo Hone
405 Hilgard Ave.
Los Angeles, CA 90024

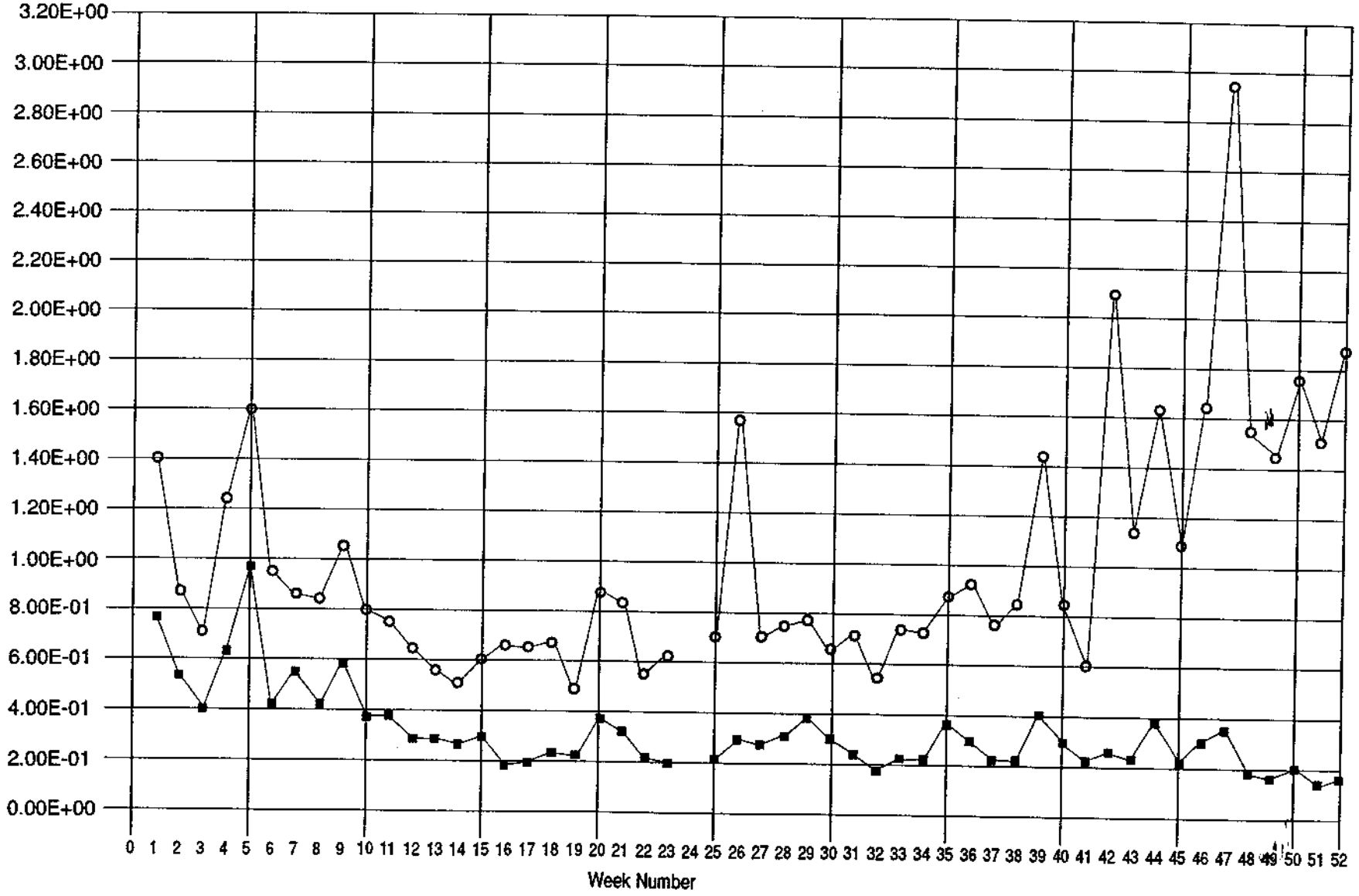
APPENDIX

Appendix 1

Gross Alpha and Beta Concentrations Reported by Location

Carlsbad

1993 Gross Alpha / Gross Beta



A-1

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Eunice

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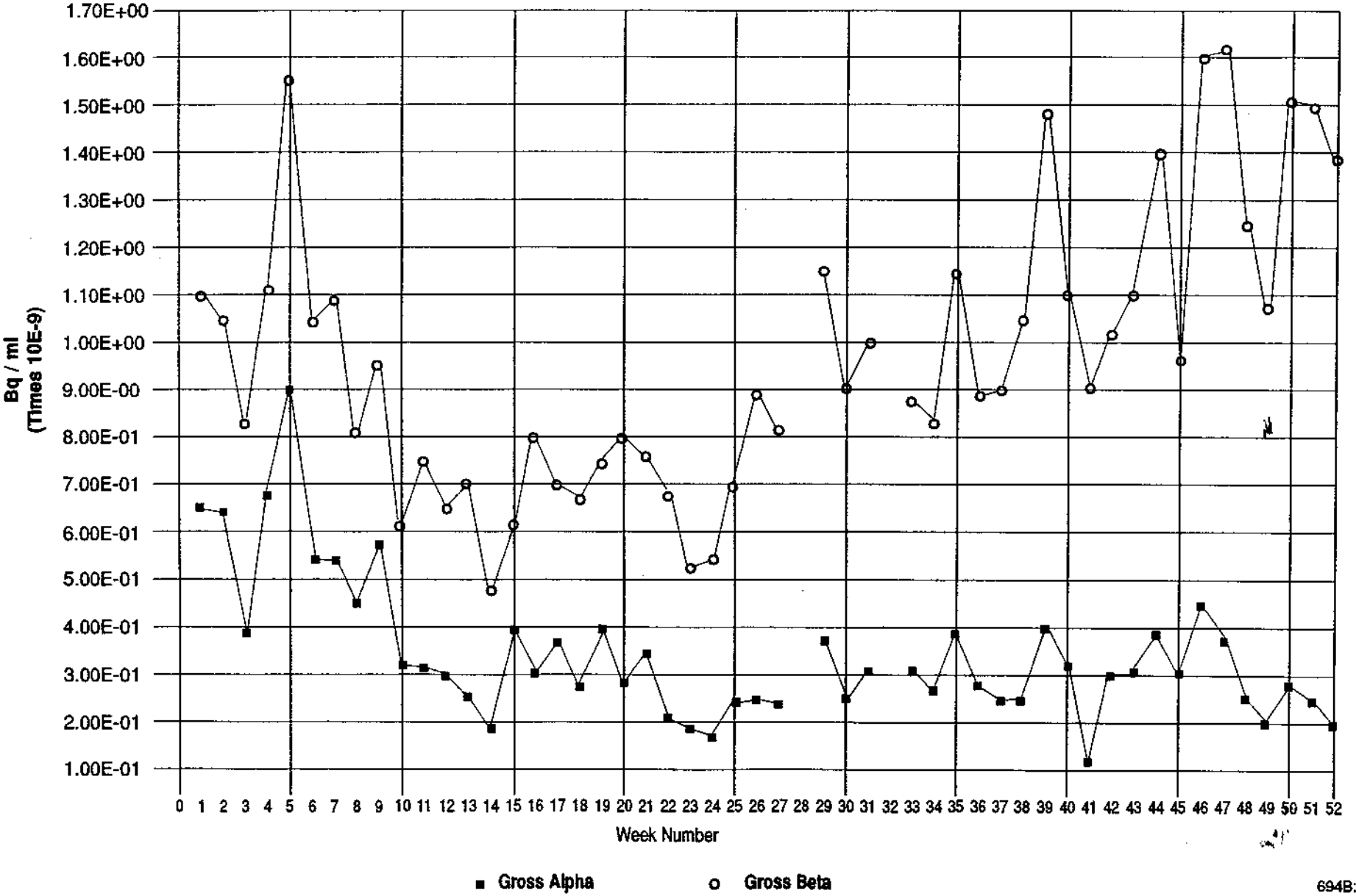

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Mills Ranch

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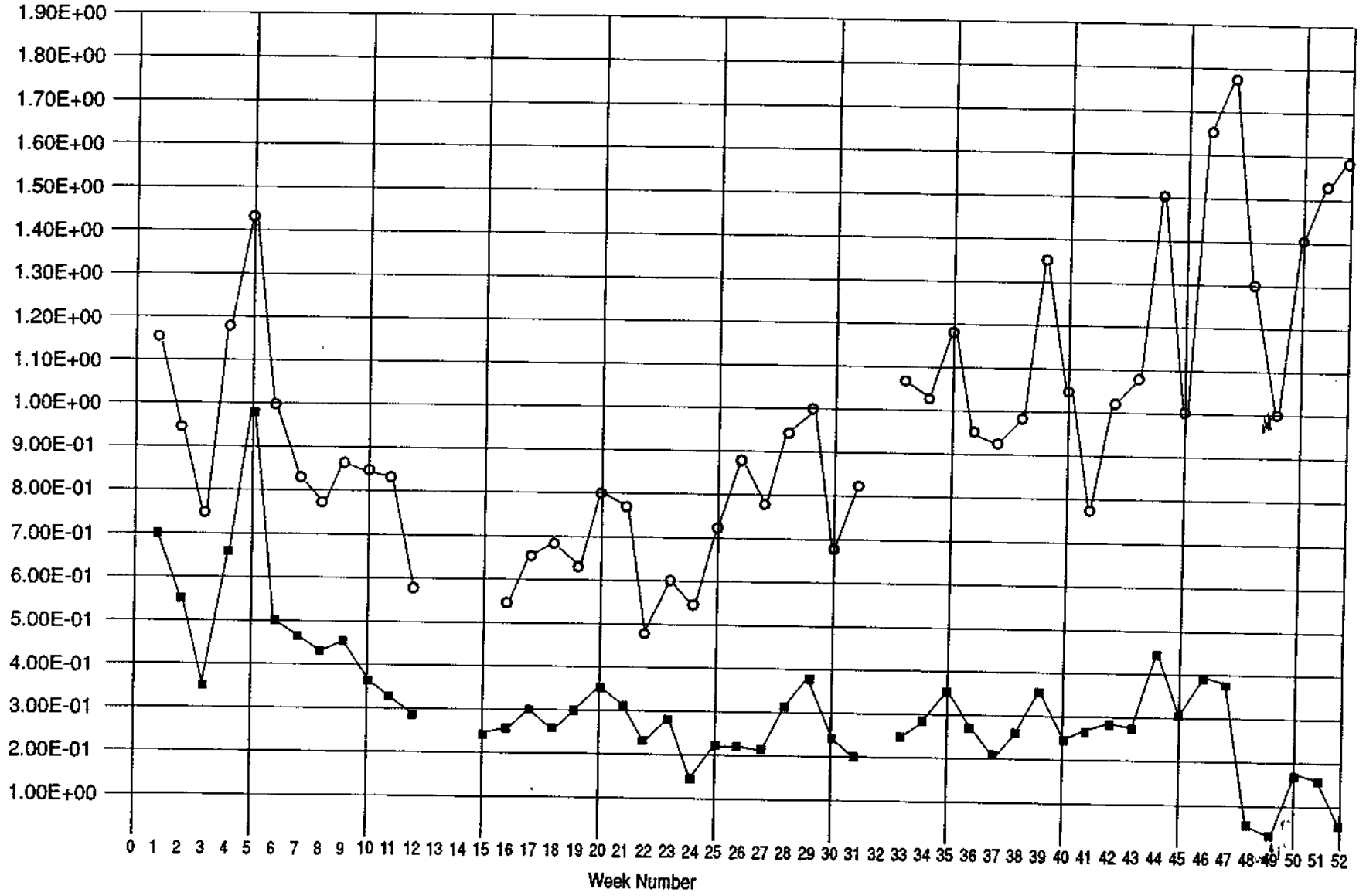

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Smith Ranch

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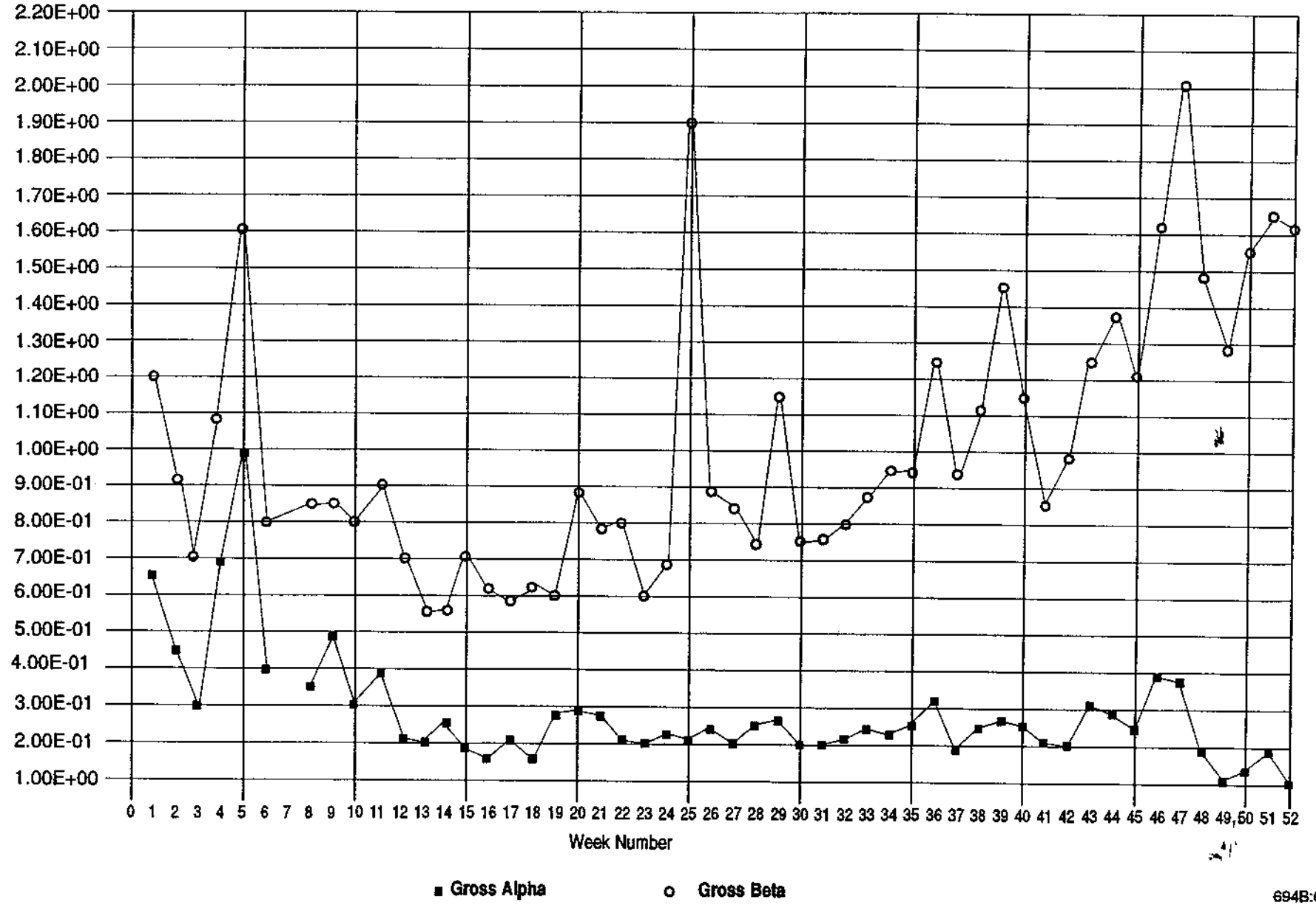

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WIPP East

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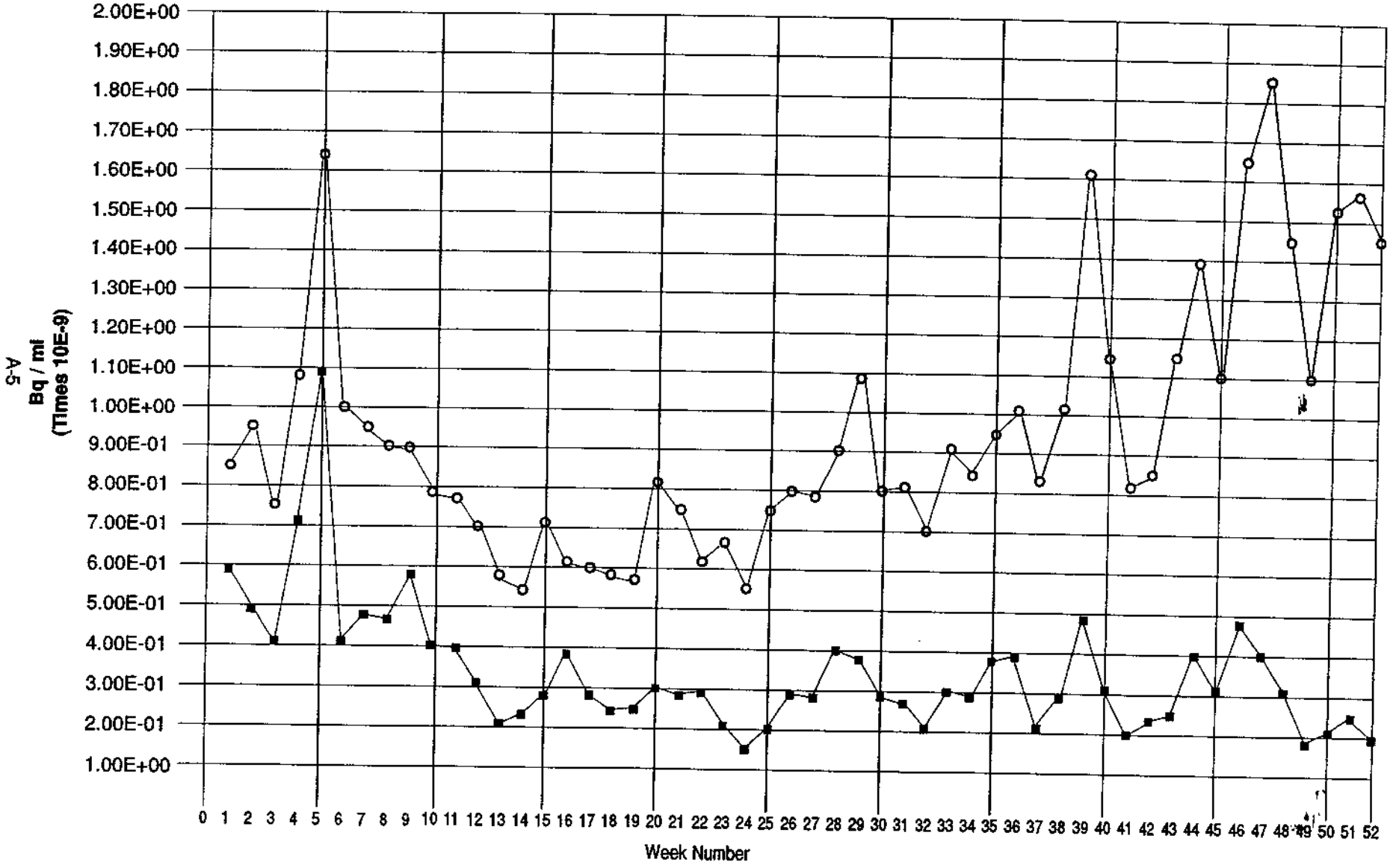

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WIPP Far Field

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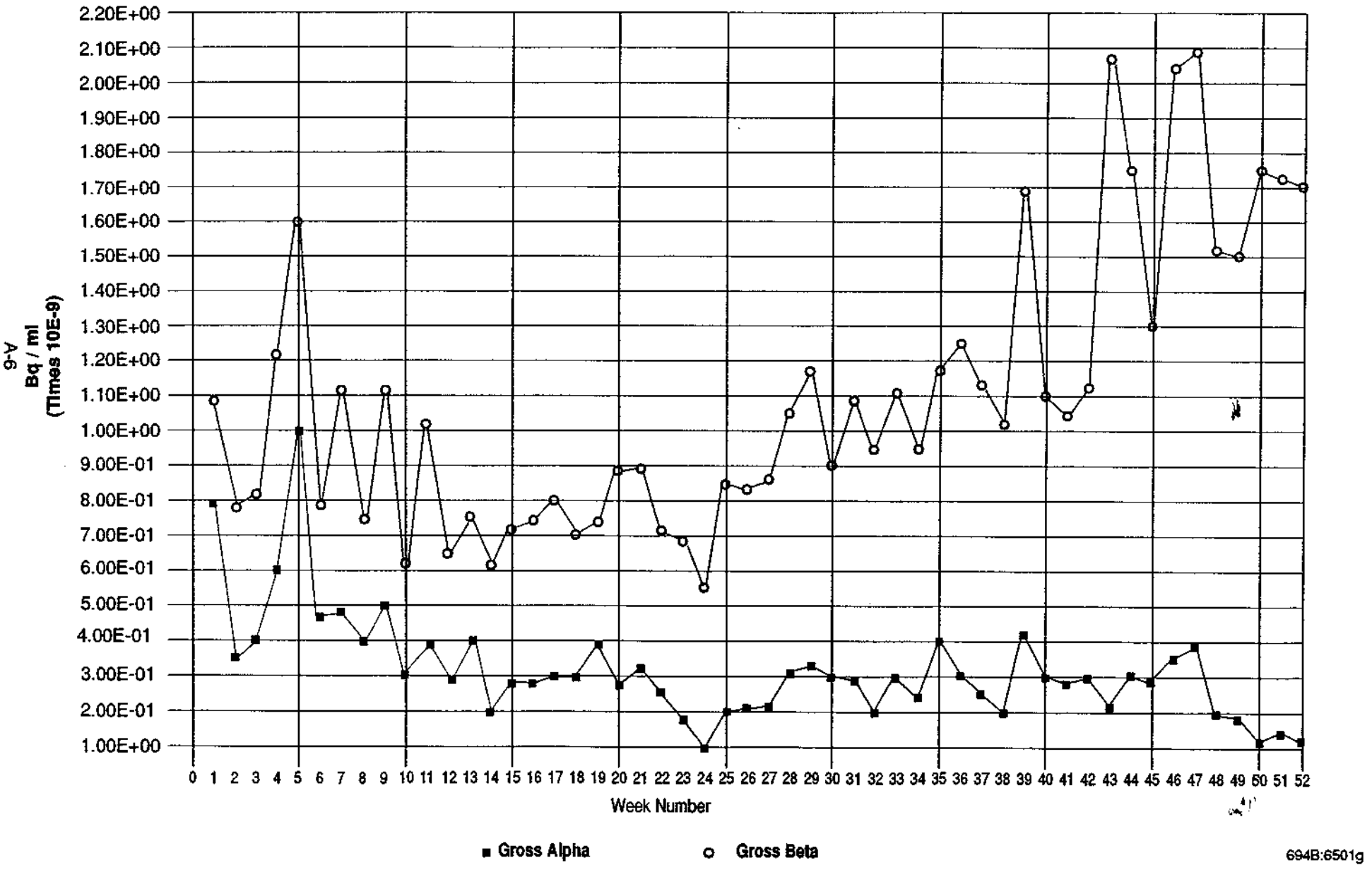

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WIPP South

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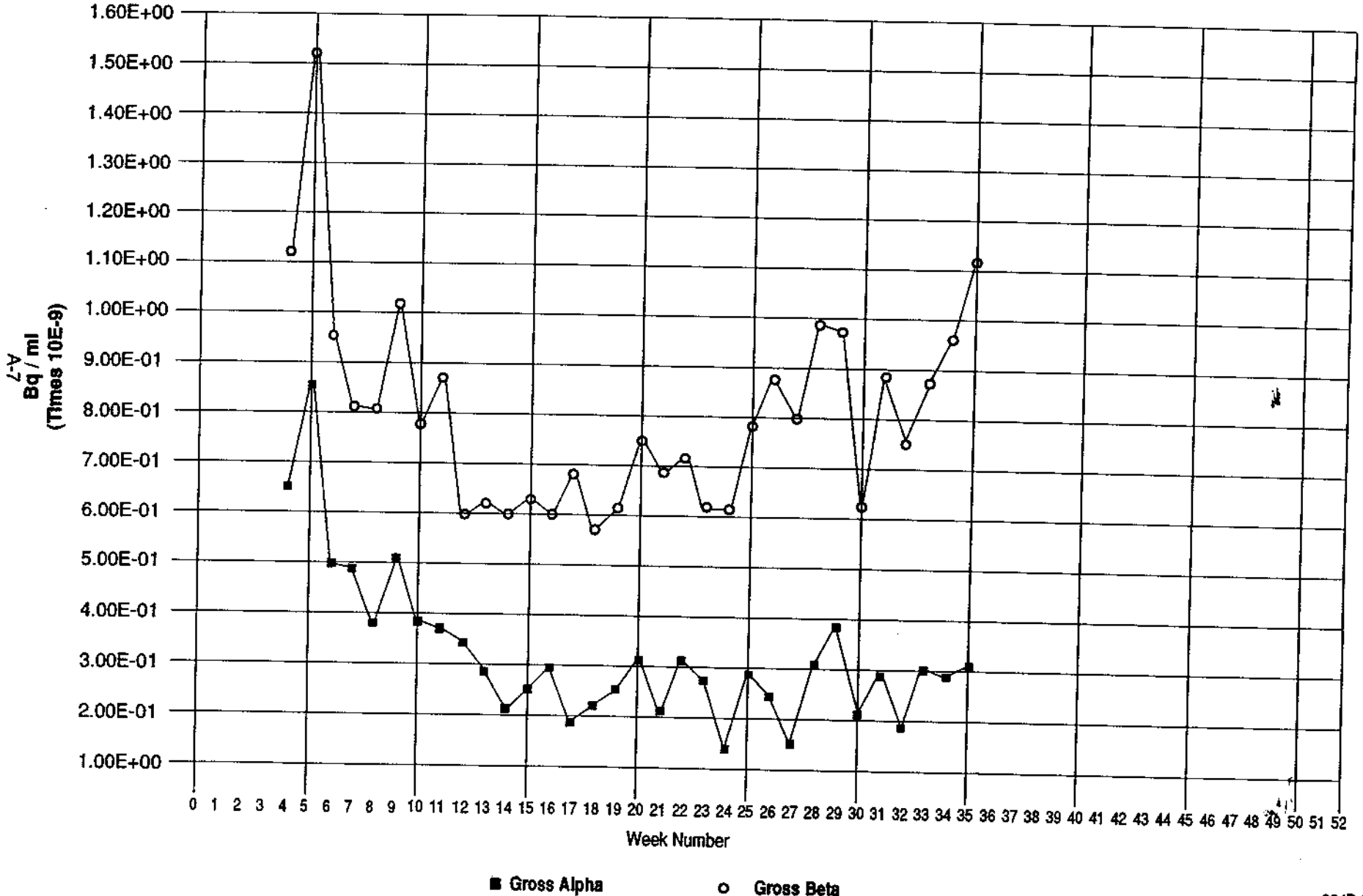

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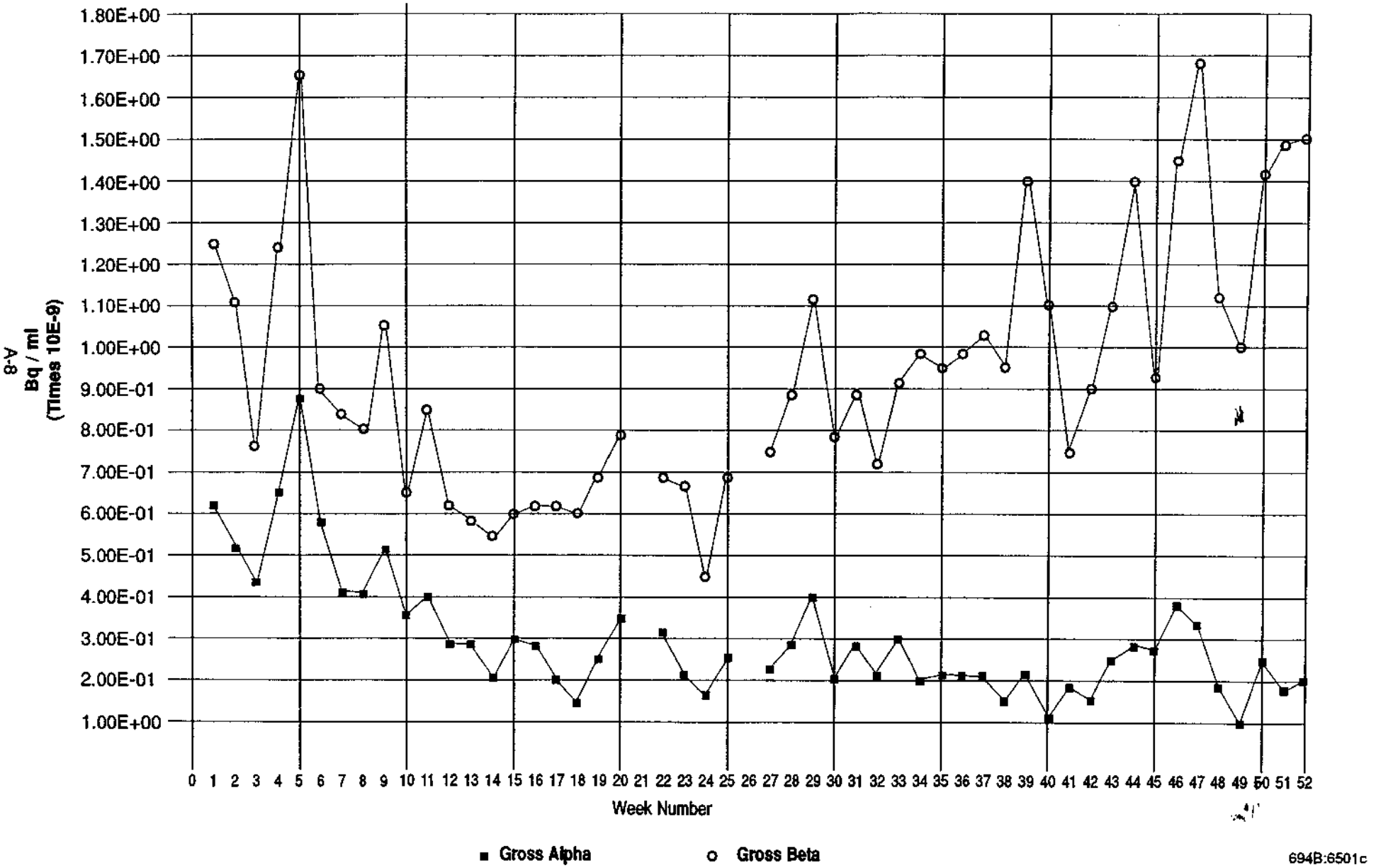
South East Control

1993 Gross Alpha / Gross Beta



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METRIC FRACTIONS

Multiple	Decimal Equivalent	Prefix	Symbol
10^{6}	1,000,000	mega-	M
10^{3}	1,000	kilo-	k
10^{2}	100	hecto-	h
10	10	deka-	da
10^{-1}	0.1	deci-	d
10^{-2}	0.01	centi-	c
10^{-3}	0.001	milli-	m
10^{-6}	0.000001	micro-	µ
10^{-9}	0.000000001	nano-	n
10^{-12}	0.000000000001	pico-	p
10^{-15}	0.000000000000001	femto-	f
10^{-18}	0.000000000000000001	atto-	a

METRIC CONVERSION TABLE

Multiply	By	Equals	Multiply	By	Equals
in.	2.54	cm	cm	0.394	in.
ft	0.305	m	m	3.28	ft
ac	0.404	ha	ha	2.47	ac
mi	1.61	km	km	0.621	mi
lb	0.4536	kg	kg	2.205	lb
liq. qt. - U.S.	0.946	l	l	1.057	liq. qt. - U.S.
ft^2	0.093	m^2	m^2	10.764	ft^2
mi^2	2.59	km^2	km^2	0.386	mi^2
ft^3	0.028	m^3	m^3	35.31	ft^3
d/m	0.450	pCi	pCi	2.22	d/m
pCi/l (water)	10^{-9}	µCi/ml (water)	µCi/ml (water)	10^{9}	pCi/l (water)
pCi/m^3 (air)	10^{-12}	µCi/cc (air)	µCi/cc (air)	10^{12}	pCi/m^3 (air)

TRADITIONAL AND INTERNATIONAL SYSTEMS OF RADIOLOGICAL UNITS

(Traditional units are in parentheses.)

Quantity	Name	Symbol	Expression in Terms of Other Units
absorbed dose	Gray	Gy	J/Kg^{-1}
	(rad)	rad	10^{-2} Gy
activity	Becquerel	Bq	1 dps
	(curie)	Ci	3.7×10^{10} Bq
dose equivalent	Sievert	Sv	J/Kg^{-1}
	(rem)	rem	10^{-2} Sv
exposure	Coulomb per kilogram		C/Kg^{-1}
	(roentgen)	R	2.58×10^{-4} C/Kg-1